American
Journal of Orthodontics
and Oral Surgery

(All rights reserved)

VOL. 25 MAY, 1939 No. 5

Orthodontics

APPLICATIONS OF THE PRINCIPLES OF HEREDITY TO ORTHODONTICS

PAUL B. SAWIN,* PROVIDENCE, R. I.

VARIATION, which in nature is universal and widespread, results from the interaction of two great forces: environment, with which the orthodontist is daily accustomed to deal, and heredity, of which he has only recently become conscious.

Like most sciences genetics has had its beginning in the simplest and most obvious sorts of observations. Characters, such as tallness and dwarfness in garden peas, hair color, hair structure and pattern, were the first to be studied. It has made its greatest progress in those animals and plant forms which reproduce the most rapidly and which lend themselves most readily to experimental control. We know most about inheritance from such a lowly form as Drosophila, the small fruit fly immortalized by Thomas Hunt Morgan, the Nobel laureate, and many of the principles laid down by these studies have been confirmed and broadened by similar studies in the laboratory rodents, mice, rats, guinea pigs, and rabbits. Even in the larger and slower breeding domesticated animals and in man himself they have been found to be universally applicable.

Thus the manner of inheritance is quite clear for several hundred human traits in spite of the impracticability and, in fact, impossibility of applying experimental breeding methods. Since the principles of Mendelian dominance, segregation of gametes and their recombination at fertilization as established in hundreds of plant and animal forms are known, it is very simple to apply them to human pedigrees.

From the biologic point of view, inheritance is essentially a matter of continuity between successive generations of living organisms and the connecting

*From the Biological Laboratory, Brown University.
Read before the New York Society of Orthodontists, New York, N. Y., Nov. 1, 1938.

link between any two generations is a single cell, the fertilized egg resulting from the union of a single ovum and a single sperm derived from two separate parents. Long years of patient research on the part of both the geneticist and the cytologist have established the fact that the fertilized egg contains all of the potentialities of the new individual, half derived from the mother by way of the ovum, half from the father by way of the sperm. These potentialities are localized in discrete invisible units (genes) arranged in a definite and orderly manner in those formed elements of the cell known as chromosomes. Such units are as easily demonstrated in the laboratory as are the ergs, atoms, and protons, units of other sciences.

Fig. 4 shows a diagram of the chromosomes; their behavior at fertilization; their manner of splitting in somatic (body cell) divisions; and of separation or reduction in germ cell divisions which result in mature gametes with one-half the somatic number of chromosomes. This reduction of genes and chromosomes

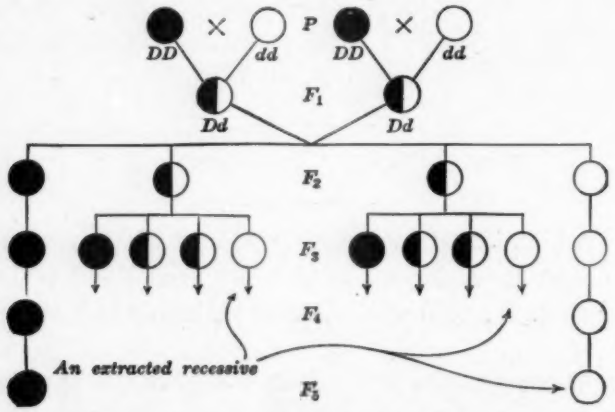


Fig. 1.—A generalized diagram of a cross between individuals differing in a single pair of contrasting characters. Dominance may or may not be complete in the first generation. In this case it is incomplete. In the second generation, as a result of segregation of gametes and their recombination, there appears a proportion of one pure dominant (black) and one pure recessive (white) like the grandparents and two hybrids like the parents. The pure parents if bred to their own kind will breed true. The hybrids will breed like their hybrid parents and a hybrid mated with a double recessive (not shown in diagram) will produce half like himself and half like his mate. (From Walter, H. E.: Genetics, 1938, Macmillan Co.)

and their subsequent recombination at fertilization which restores the full complement of genes and chromosomes in the new individual constitutes the physical basis of inheritance.

However, for every character or trait which is inherited in a simple Mendelian manner such as those above, experience shows that there are several which are complicated by other genetic or environmental influences. Especially is this true of physical and physiologic traits.

For example, a considerable number of human pedigrees of missing or supernumerary teeth have been reported, and the inheritance of these is clear in most cases. Malocclusion and the size and shape of the jaws and teeth on the other hand are not so well understood. These latter variations are not qualitative in nature, being either present in the individual or absent. They are naturally quantitative, manifesting a considerable range of expression which is frequently demonstrably influenced by the environment.

Variations may be arranged roughly in a series depending upon the relative influence of heredity and environment in producing them. As Snyder[21] has pointed out, at one extreme would be those variations which are completely the result of the environment, heredity being so similar in all the individuals involved as to play no part in the observed variation of the character. Such a

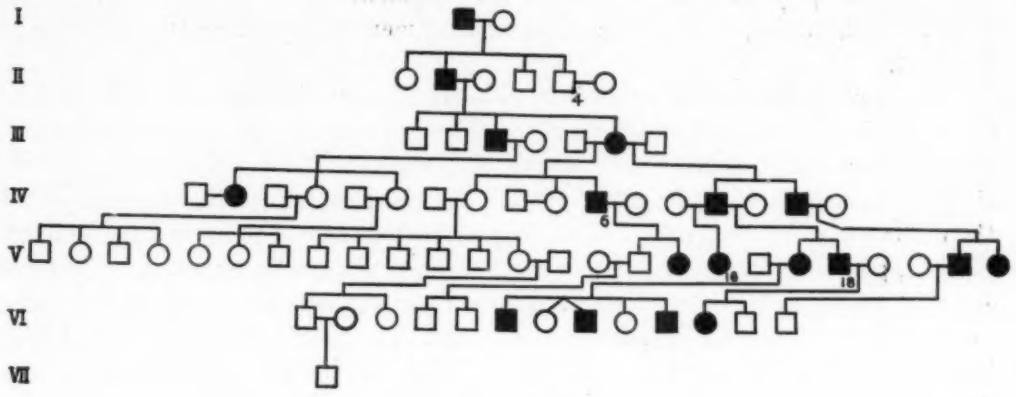


Fig. 2*A*.

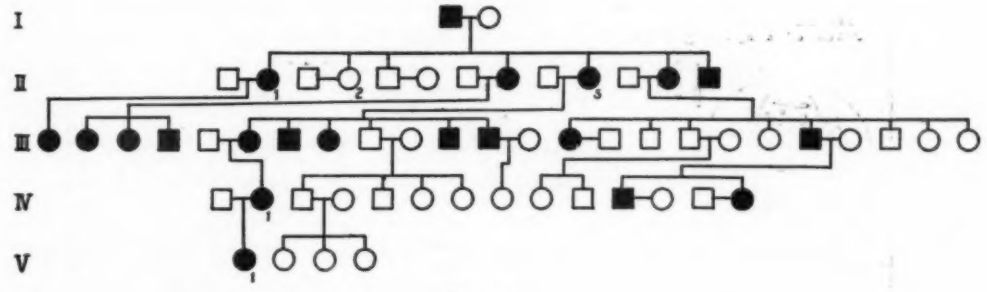


Fig. 2*B*.

Fig. 2*A*, *B*.—*A*, Pedigree of family with enamel deficient teeth; *B*, five generations of defective teeth. The application of these principles to actual human pedigrees of a character known as "soft brown teeth lacking white enamel." It is a dominant since it is transmitted continuously from one generation to the next, in approximately equal proportions. It usually is in the hybrid condition since abnormals rarely marry. Normal progeny which are recessive breed true. (From Clark F., and Clark C.: Absence of Tooth Enamel, J. of Hered. 24: 1933.)

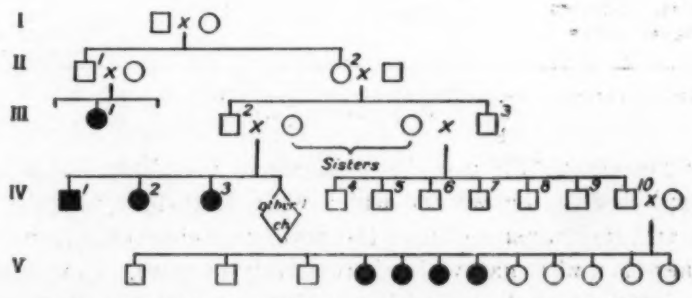


Fig. 3.—A pedigree in which a simple recessive trait such as albinism is segregating. Such a trait skips generations only to appear unexpectedly, sometimes several generations removed from the original progenitor. For that reason it is more difficult to detect. Fortunately most morphologic variations are dominants. (From Gates, R. R.: Heredity in Man, 1929, Macmillan Co.)

trait is syphilis. Everyone, so far as we know, inherits a susceptibility to the disease. Whether a person contracts the disease depends entirely upon the environmental contact with the causative agent.

At the other extreme are those variations due entirely to forces inherent within the individual and which no known environmental influence may alter. Such a character is true albinism, as it is found in the rabbit, rat, and man where there is a complete absence of any form of pigment. If a person or animal inherits the character, no known sort of environment may induce the presence of pigment.

Between these two extremes is a wide range of variations which in a major or minor degree are influenced by both. For example in the case of diphtheria, Hirszfeld and co-workers[16] have shown that susceptibility is dependent upon a simple recessive factor, yet infection with the causative agent is necessary before the disease may be contracted. Thus in a given population where all the individuals happened to inherit susceptibility but only some were exposed, only those exposed would contract the disease. In the first case heredity is the determining factor, in the latter case it is the environment. The point, of course, is that both heredity and environment are at work in the production of most characters. Particularly is this true of physical characters, including the developmental abnormalities of the human jaws and teeth.

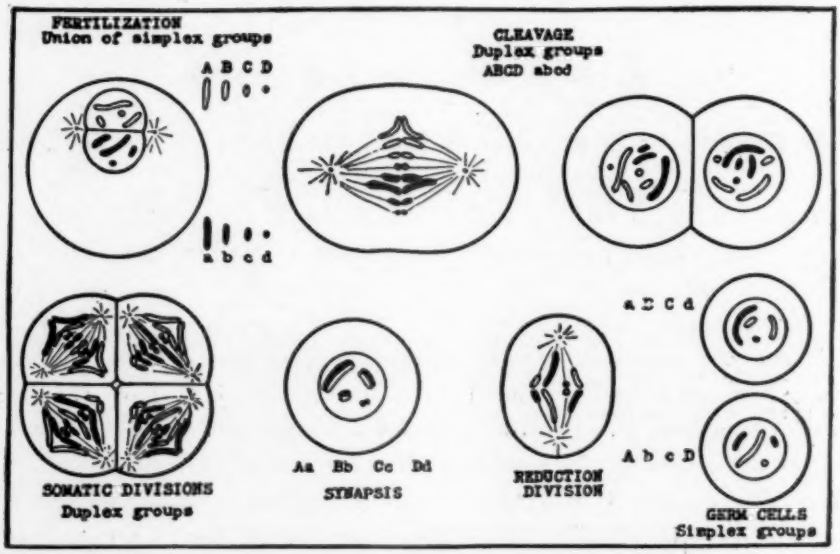


Fig. 4.—Diagram of chromosome cycle. (From Sharp, L. W.: Introduction to Cytology, 1934, McGraw-Hill Co.)

As a further complication of the analysis of heredity, it should be pointed out that, in spite of the knowledge which we possess today of the genes in the chromosomes and the transmission of the developed character from individual to individual, there is a wide gap which is relatively obscure. How can a gene, or a group of genes transmitted at fertilization influence the development of a character? What is the connection between a gene effecting spotting and the appearance of white spots in the coat color of the animal? How do genes result in color blindness, blue eyes, missing or supernumerary teeth, etc.? Theories as to the

development of the individual such as those of preformation and epigenesis are old. Their popularity has fluctuated like the changing fashions in clothes and almost as frequently. Of recent years, however, the application of experimental techniques to the study of controllable organisms in the laboratory has paved the way for a better understanding of at least some of the specific growth and developmental processes which are gene controlled.

As a consequence the ways in which genes are known to act in effecting the differentiation of characters are known to be many and varied. I have time to call attention to only a few of them. They may so affect the cytoplasm of the fertilized egg as to produce early and far reaching changes, or they may affect the development of a structure appearing late in differentiation. They may speed up development, or they may retard it. If they retard it at a critical period, the production of that character may be inhibited altogether.

One of the most interesting characters to study from the standpoint of genetic development is coat color, because it is extremely variable within many species and also because we know something of the chemistry of color and pigment formation in animals. Animal pigments in the eyes, skin, and hair require the presence of the chromogen tyrosine and the action upon it of the catalyst dopa-oxidase. In Drosophila, potato beetles, rabbits, and many others genes are known which inhibit one or the other of these chemical components of the skin and thus modify the color of the organism or of its parts. Here we have an example of a character altered in various ways by genes which do so by causing the presence, reduction, or absence of definite and demonstrable chemical reactions.

More closely related to the problems of dentistry are the hereditary aspects of vitamin D deficiency which have been studied intensively by Gowan.[11] He has found that separate inbred (homogeneous) lines of rats show distinct inherent differences with respect to the ability to assimilate this vitamin. Therefore they show distinct differences in their dietary requirements. If this situation occurs in other domesticated animals, and it probably does, it may likewise occur in man. It means that a diet that is favorable to one family or to one individual within a family may not necessarily be adequate for all families or all individuals. It means that the practicing physician, dentist, and orthodontist must learn not only to recognize the symptoms of these deficiencies in all of their various stages but also to check the diet of the parents and to look for evidences of the former existence of the condition in the parent perhaps at a specific age, when the individual may have been more susceptible to it.

Some characters are the result not only of definite chemical reaction but are influenced as well by the element of time, which may likewise be gene-controlled. Wright[26] after breeding hundreds of guinea pigs and long and careful study has interpreted the wide range of types associated with otocephaly (ear and head abnormality) in the guinea pig as being due to the relatively direct and precise action of a gene at a definite period in embryonic development. Bonnevie[3] has found, after a similarly careful study, that the hereditary anomaly known as pseudocephaly in mice is caused by a recessive gene which very early affects the primary head mesoderm in such a way that its growth is exceeded by that of

neighboring ectodermal parts which forces a folding of the brain and other mechanical consequences. The mutation thus destroys the proper timing of two major interdependent developmental processes by changing the rate of only one of them.

Along this same line are those examples of genes which are known to cause the fixation of a definite developmental stage such that an embryonic condition is carried over into the adult stage. Reed[18] has studied the inheritance and embryology of harelip and cleft palate in the mouse and finds them to be due to incomplete concrescence of embryonic parts. The inheritance is relatively simple but differences in their expression depend upon the sex of the individual, the size of the litter in which the individual is born, the age of its mother, asymmetry of the clefts, and in a large part upon intangible chance factors. Inheritance studies of this character in man show it to be strikingly similar to that in mice. Reed concludes that "probably the genetic and environmental mechanisms involved are nearly identical."

Still another example where animal experimentation may lead to clues, in this case to the cause of malocclusion, may be cited in the observations and studies of Grüneberg[15] on the "gray lethal" mutation in mice. Among other visible manifestations this mutant causes deformed incisors and first molar teeth of a nature resembling the condition "delaceration" found in the more exposed teeth of man and which is due apparently to the failure of the jaw bone to make a proper response to pressure and resorption.

What happens is this. At the time when the then uncalcified tooth germ is about to become enclosed in the socket, it has not yet reached its definite size. Now, when it grows in a normal animal the surrounding bone responds by absorption of the bone to fit the requirements of the growing tooth germ. Under normal conditions, therefore, shape and size of the socket are always in harmony with the dimensions of the tooth. In other words, growth tendencies of the tooth determine size and shape of the socket.

In "gray-lethal" mutation this situation is reversed. Here the bone of the socket does not yield to growth pressure of the tooth germ. Accordingly, the tooth germ has to adapt itself to the space available. It does not respond by stopping growth altogether, but the growing germ, which is chiefly the enamel organ, is therefore bound to become deformed. In the mandibular first molars compensation occurs by growth in an anterior direction. In maxillary first molars it occurs by erection of the cusps or by vertical growth.

From the work of Gottlieb and Orban[12] it is well known that bone responds directly to pressure by absorption. The ability of bone to respond to pressure is rooted in hereditary factors. If these factors act normally, the relationship between pressure and absorption is direct. If this hereditary mechanism is upset as in the "gray-lethal" case, the stimulus by itself is unable to induce absorption of bone.

In the hierarchy of causes, therefore, the bone anomaly is nearer the original gene action than are the tooth shape anomalies dependent upon it. The

gene here causes primarily a failure of bone resorption and secondarily the tooth anomalies.

Another very interesting type of experiment has been carried out by Stockard,[22] who for a number of years has been studying crosses between several breeds of dogs. He has shown that the maxilla and the mandible may be developed independently of each other. In a cross between a breed of dog possessing a short muzzle like the English bulldog with that possessing a long muzzle like the bassett hound, there uniformly occurs typical dominance of the long jaws of the bassett hound in the first generation. In the second generation there arise individuals some of which possess the long maxilla and skull of the bassett hound and the short mandible of the bulldog and vice versa which leads to all types of malocclusion.

The specificity of genes affecting the maxilla and the mandible, manifest in Dr. Stockard's dogs, is a bit surprising in view of the fact that phylogenetically the maxilla and the mandible jaws are of the same ancestral origin. Actual specificity may, however, be more apparent than real for it seems that along with these variations in the jaw and other parts of the body are also variations in the pituitary gland. Using Stockard's own words, I quote, "Experimental investigation of the relationship between the structural deviations and the peculiarities of the pituitary seem to indicate that the pituitary secretions are not strictly growth promoting in their influences but rather exert growth-coordinating effects. Ordinarily these influences bring about a harmonious pattern of all organs and parts in the body complex. When the pituitary is defective or deranged as it is in hybrid segregants, the growth-regulating influence is lost or weakened and various overgrowths and disharmonies in structural proportions occur. Certain tissues are more susceptible to this growth regulation than others, and skeletal structures are apparently particularly susceptible." Stockard here has traced the specificity of the gene to a derangement of the pituitary.*

This problem of the specific vs. localized effect of given genes is perhaps one of most fundamental importance to the orthodontist. For example, Abel, as described by Berger,[2] studied crosses of Bushmen, Hottentot, and Negro and came to the conclusion that size of teeth and size of jaw are independent and not a part of the general size pattern. On the other hand Hrdlicka in studies of innumerable crosses of white and negro, white and Indian, Eskimo and many other races finds no disharmonies under normal conditions. Here are two conflicting interpretations partly explainable by the difficulties of securing complete and reliable genetic data for interpretation in human studies. Castle[4] and others in experiments conducted over a long period of years on laboratory and domesticated animals, where breeding experiments may be carried out under completely controlled conditions, have answered the same sort of problem much more conclusively. They have shown that, when races of unlike body size are crossed, the offspring are, in general, intermediate in size, both in the first and in later generations of offspring.

*Dr. Stockard has in press at present a further discussion of these crosses, particularly dealing with the jaw variation.

Most investigators in this field are convinced of the universal validity of Mendel's laws and have accepted what is known as the multiple factor interpretation of such cases. Castle,[5] Green,[13] and others have been able to show with reasonable certainty that some differences in general body size are due to genes resident within the chromosomes, and furthermore by embryologic studies Gregory and Castle[14] have been able to show that the eggs of small and large sized rabbits although of the same initial size developed at different rates.

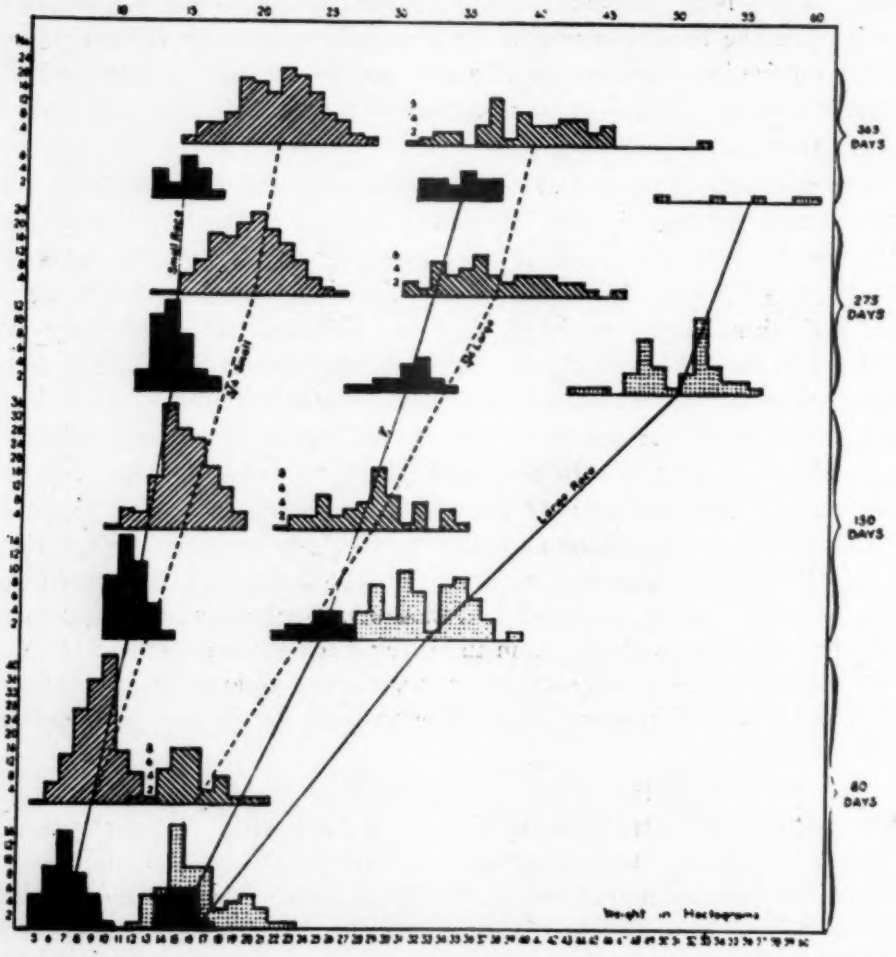


Fig. 5.—The histograms for body weight of small and large sized races of rabbits at 80, 150, 275, and 365 days; also for the F_1 and for ¾ and ¼ blood backcross progeny as indicated. Distributions fall into normal frequency curves such as are to be expected where numerous genetic or environmental forces are involved. Hybrids are in each case intermediate between respective parental groups. (From Castle, W. E.: Size Inheritance in Rabbits, J. Exper. Zoöl. 60: 325, 1931.)

Those of the large size undergo cleavage much more rapidly and thus produce a larger embryo, and this rapid rate of growth persists until adult size is attained. But genes which affect the general rate of growth probably are not the only ones influencing body size. Davenport[7] from his studies on man and Sumner[23] from his on mice believe that general factors control growth to a degree much less than half. Wright,[25] in a careful statistical analysis of Castle's data, confirms Castle's interpretation to the extent that factors for general size are

much the most important in determining the size of each part. But, he also indicates the existence of group factors for the forelimbs and hindlimbs collectively and for the hind limbs separately. He comes to similar conclusions with respect to Dunn's data on the fowl. These specific differences, however, are only distinguished by a statistical technique which is not practicable for anyone but a trained biometrician. It would be much more helpful if biologic landmarks could be obtained which would tag such areas of localized differential growth more clearly. In this connection a study of skeletal variations in which I have been interested for several years seems to offer some suggestion. Among domesticated rabbits four different arbitrary types can be differentiated with respect to the number of ribs and presacral vertebrae.

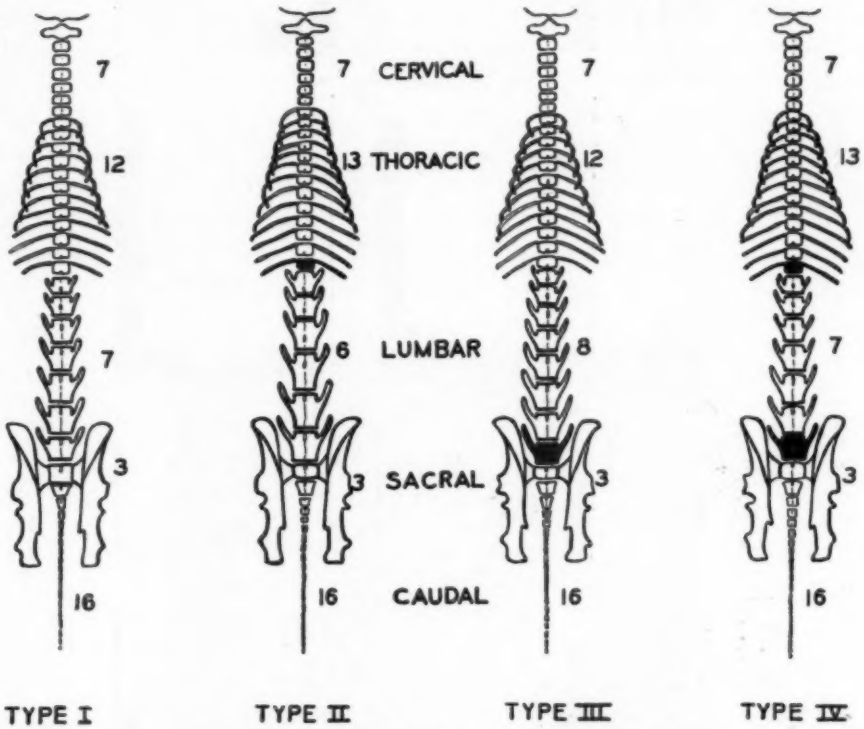


Fig. 6.—Type I shows an animal with twelve pairs of ribs and seven lumbar vertebrae; type II with an extra pair of ribs; type III with an extra presacral vertebra; and type IV with both. (From Sawin, P. B.: Preliminary Studies of Hereditary Variations in the Axial Skeleton of the Rabbit, Anat. Rec. 69: 1937.)

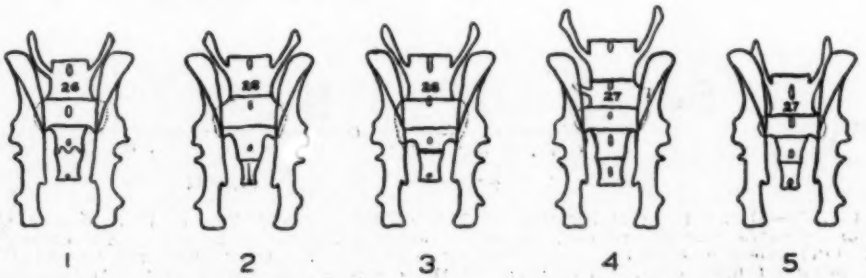


Fig. 7.—The range of variation in the union of the pelvis and sacrum according to whether it involves the twenty-seventh or twenty-eighth vertebra or both. A similar range of expression of the extra ribs can also be arbitrarily made. (From Sawin, P. B.: Preliminary Studies of Hereditary Variations in the Axial Skeleton of the Rabbit, Anat. Rec. 69: 1937.)

Although the variation in the expression of the extra ribs and presacral vertebrae is such that one cannot point to a single and specific gene for each skeletal unit, their inheritance is nevertheless quite regular. The fact that the two variations (sacral and rib) do not coincide exactly suggests that they are not due to the same inherent forces. Presence of extra ribs is recessive to their absence, whereas the expression of an extra presacral vertebra tends to blend.

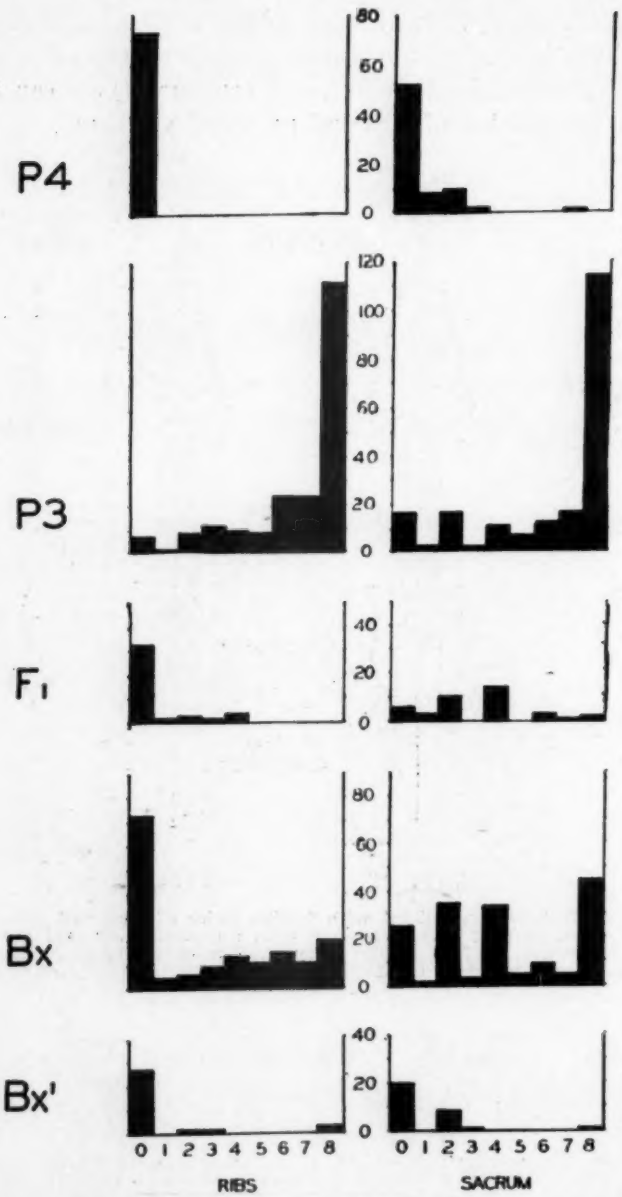


Fig. 8.—Shows the classification of 593 individuals according to their degree of manifestation of extra ribs in one column and of extra presacral vertebrae in the other. In one family (P_4) selection over several generations has been for the normal number (12) of ribs. In the second family (P_3), it has been for the complete expression of the thirteenth pair of ribs. When these two families are crossed we see that in the F_1 the twelve-ribbed condition appears almost to the complete exclusion of the thirteen, but the sacral types of the two families appear to blend. In the backcross generation (B_x) ($F_1 \times P_3$) there is evidence of segregation of both types of rib condition in about equal numbers although the expression of the thirteenth ribs is variable, and the sacral type again seems to blend. In the B_x' generation ($F_1 \times P_4$) only the twelve-ribbed type is prevalent but the sacral type again is a blend.

Therefore, it would seem that these skeletal units are reliable indicators of a change in rate of growth or differentiation in the somewhat localized area in which they exist. If it is true that ribs and presacral vertebrae are tags of the localized growth taking place in their respective regions which is gene controlled, it may also be that localized underdevelopment and overdevelopment of the jaw are likewise gene controlled, and that close scrutiny will disclose similar landmarks which, when studied under controlled conditions, will disclose the nature of its hereditary underdevelopment or overdevelopment.

Another fact most clearly brought out by these studies on the rabbit is that in dealing with physical characters too much emphasis cannot be placed upon interpretations based upon small numbers of individuals. In 1932, when the rib studies were first undertaken, simple pedigrees, such as those already shown of defective enamel and albinism, indicated a single specific gene for extra ribs. As the investigation of this character progressed, it became increasingly evident that the gene action in this case is more general in nature, and, although so many animals have been bred, the definition of the character is still incomplete. For that reason human studies in which families are necessarily small should be supplemented by studies of homologous variations in the more closely related mammals. In order to demonstrate inherent forces in jaw development, crosses are needed between pure strains of two species which, when raised in

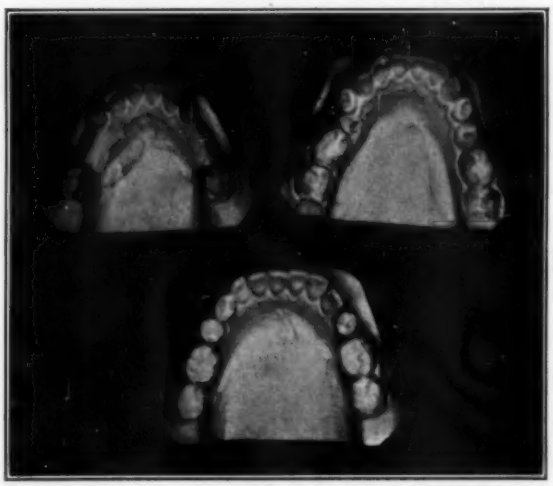


Fig. 9.—Simian shelf in mother (below) and daughter.

the same controlled environment, differ in several types of jaw and tooth characteristic. This should be accompanied by a thorough study of the developmental changes which occur in succeeding generations of controlled matings. They should be further supplemented by controlled experiments upon the same inbred strains which will demonstrate the exact influence of environmental forces. What is needed is accurate description of all developmental processes with techniques for measuring and timing all variations. Until such a groundwork is laid and followed up step by step with comparative studies in man, it will be difficult to speak with assurance of the development of the jaw or of the possibility or impossibility of its treatment.

We have seen how the genes induce chemical and physical reactions which alter form and function in the lower experimental animals. I will give just a few cases which suggest a similar basis for variations in the human jaw.*

In Fig. 9 the prominent simian shelf in both mother (below) and in daughter at ages 8½ and 12½ years is shown. It is important for two rea-

Fig. 10.—The little girl has a mandible which is larger than the maxilla, originally believed to be the result of premature loss of canines. Note that the profile is not unlike either parent.

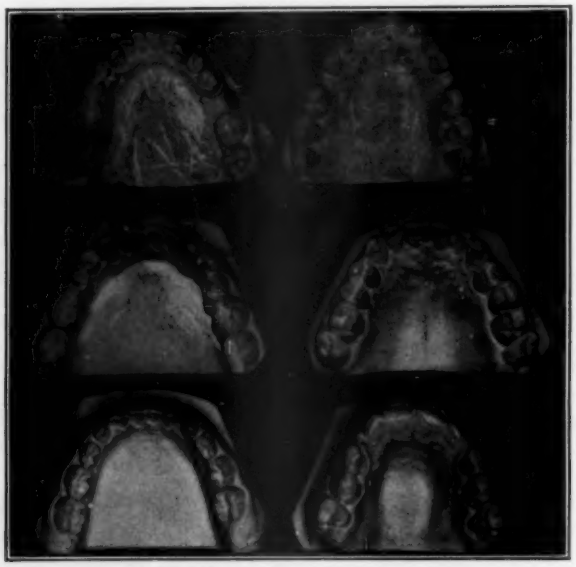


Fig. 11.—The width of the posterior part of the dentitions of the father and child (Fig. 10) is abnormally wide (Pont index 7-11 mm.) in the posterior regions, a characteristic of the American Indian. The father's pedigree traces seven generations to a mating of a pure blood Indian squaw and an English nobleman.

sons: First, although the present observations can hardly constitute proof of a hereditary background, the anomaly is so relatively rare that its appearance in two successive generations is very suggestive and warrants further study of

*These are taken from the practice of Dr. M. LeBow to whom I am greatly indebted for his interest and cooperation.

this and other case family histories. Second, the appearance of the character at 8½ years indicates that form is already well established at a very early age.

This little girl in Fig. 10 has a mandibular jaw which is larger than the maxillary. The original diagnosis of the case was that the maxilla was smaller because the temporary canines were prematurely lost. However, the family pedigree shows that, whereas in profile the little girl is not unlike either father or mother, in measurements her jaws are quite unlike the mother's but relatively identical to those of the father.

The width of the posterior part of the dentitions of both father and child is abnormally wide (Fig. 11). In fact the Pont index shows a plus 7-11 mm. in the posterior regions. In discussing the case, it was learned quite by accident that the father's pedigree traces seven generations to ancestors one of which was a pure blooded Indian squaw, the other an English nobleman. Three generations ago one of his great-grandmothers was almost Indian in appearance having long, straight black hair and extreme longevity, living to be 106 years of age. It is of interest to note that this type of jaw corresponds with the description of Bean[1] for the American Indian and is very rare among whites. It is not illogical to assume that this Indian trait has been transmitted for eight generations although there have been a large number of white marriages intervening about which there is little known so far as the character is concerned.

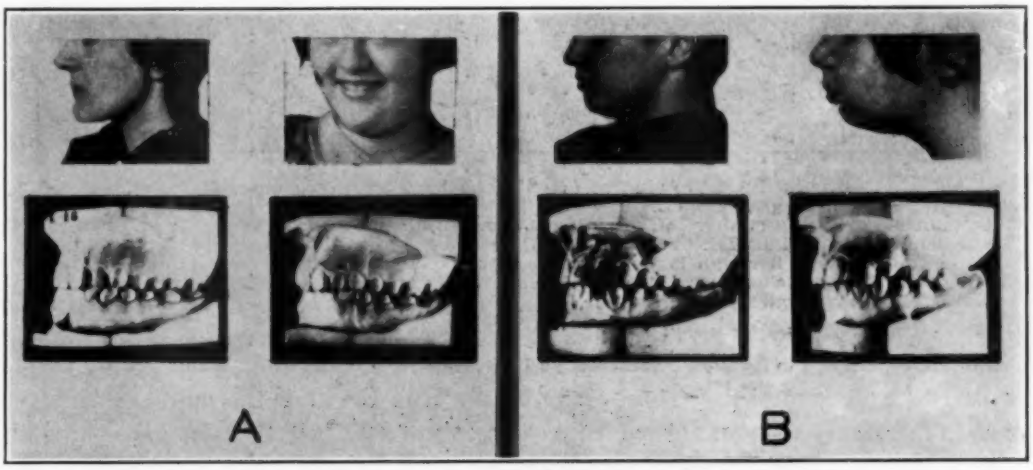


Fig. 12.—Four cousins are shown who possess a similar defect in the nature of an overbite of the maxilla. The two sisters of family *A* responded to treatment, whereas no amount of effort was successful in developing prominent chins (See Fig. 13).

Fig. 12 shows four cousins who had similar abnormalities. Two of them are sisters belonging to family *A;* the others, also sisters, belong to family *B*. Their respective fathers are brothers. They possessed a similar defect in the nature of an overbite of the maxilla.

In the case of the two sisters of family *A*, no difficulty was encountered in securing normal jaw relationship. In those of family *B*, however, it was very difficult. Similarly prominence of chin was easily obtained in family *A* because it was already there, but in family *B* no amount of effort was successful

in developing prominent chins. No satisfactory explanation was available for this difference in reaction until the pedigree of the two families was worked out.

It is seen in Fig. 13 that in family *A* prominence of chin is traceable directly through each generation from the great-grandmother in generation I. This continuity of inheritance from generation to generation is typical of Mendelian dominant characters. In this case the trait is probably intensified by the prominence of chin type introduced by the mother III. In contrast family *B* shows the same weakness of chin in both father III and daughters IV

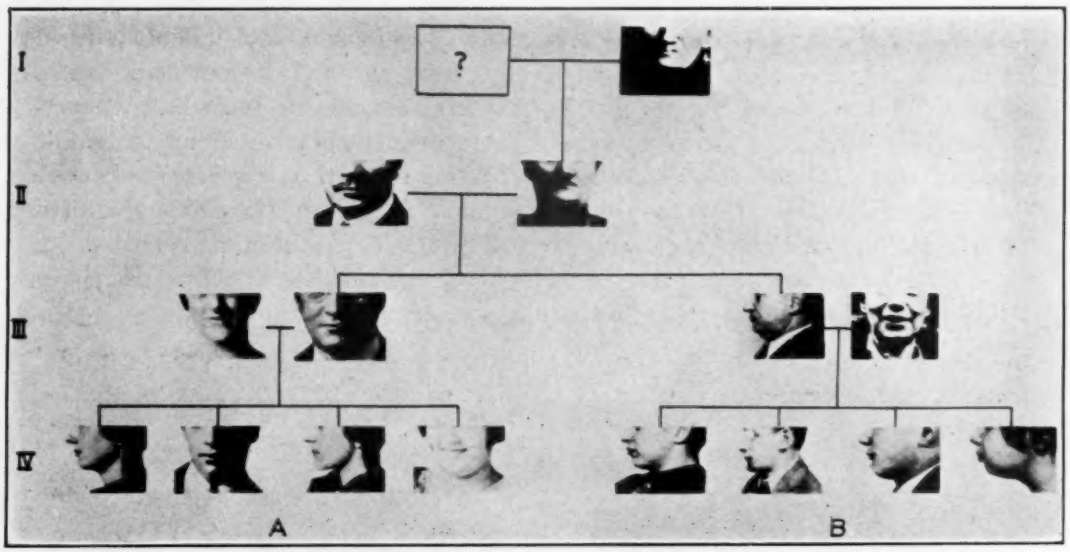


Fig. 13.—In family *A* prominence of chin can be traced through each generation to the great-grandmother in generation I. The trait is probably intensified by the prominence of chin type introduced by the mother III. Family *B* shows the same chin weakness in the daughters as is found in the father III. The mother III may also be assumed to be a carrier, since in spite of the fact that her chin is well developed only one son (third from left in IV of family *B*) possesses her jaw character. Her daughters (IV of family *B*) resemble their father and the other son his great-grandmother I.

which may have been introduced in a previous generation and carried along as an inherited recessive trait. Assuming that such is the case the mother III may also be assumed to be a carrier since in spite of the fact that her chin is well developed, only one of her children (the son IV, third from left in family *B*) possesses her jaw characteristics. The daughters IV resemble their father, and one son IV (second from left in family *B*) resembles his great-grandmother I.

The fact that the weakness of chin in the present data appears for the first time from the parents of generation II, both of whom had prominent chins, coupled with what appears to be typical Mendelian segregation in family *B*, suggests that chin form of this type is in this case transmitted in a simple Mendelian manner, prominence of chin being dominant to the receding type. Proof of this interpretation is not possible with such few numbers of individuals, but the pedigree is very suggestive and should be supplemented by studies of other families.

SUMMARY AND CONCLUSIONS

Physical characters in man and in laboratory and domesticated animals, including those of the jaws and teeth, may be inherited in a simple Mendelian manner induced by discreet units, the genes in the chromosomes. They may also be the result of the combined effects of numerous genetic and environmental forces in which case their analysis is more difficult.

In the first case simple pedigree analysis of the trait may be adequate. In the latter case it is usually inadequate, especially in man where the number of progeny is small and pedigree data at best are unreliable and genetically uncontrollable. Breeding experiments with lower animals possessing similar variations may be very helpful. From such studies we know that some genes are known to effect definite chemical reactions (as in coat color and vitamin D deficiencies); others affect the time at which physiologic processes take place, even to the projection of embryonic structures into the adult stage (as in harelip); others control the rate of growth of the whole or of its parts (as in pseudocephaly, body size or rib and vertebral variations); and still others determine their morphologic effect through the medium of an altered endocrine or other physiologic disturbance (as in the case of Stockard's dogs and the teeth of Grüneberg's mice).

Thus we see that no general rule for the genetic nature of physical variation as a group can at present be laid down. Each variation must be approached from the standpoint of its own behavior, first from the approach of pedigree analysis and, if necessary and possible, from the approach of experimental breeding of animals possessing similar variations.

New pedigrees of characters such as simian shelf, width of dental arch, and variation in prominence of chin are presented to illustrate how the question of inheritance of these variations may be approached. They do not constitute proof of any type of inheritance or even that any of these variations are inherited, but, as the basis of a working hypothesis, they are highly suggestive, and it is to be recommended that greater interest be taken in establishing the complete family history of cases of these types.

REFERENCES

1. Bean, R. B.: The Races of Man, University Soc. Inc., 1932.
2. Berger, H.: Am. J. Orthodontics **24**: 136, 1938.
3. Bonnevie, C.: (*See* 10, Goldschmidt, R.)
4. Castle, W. E.: Size Inheritance in Rabbits, J. Exper. Zoöl. **60**: 325, 1931.
5. Idem: Size Inheritance in Mice, Am. Nat. **70**: 209-217, 1936.
6. Clark, F., and Clark, C.: Absence of Tooth Enamel, J. Hered. **24**: 425, 1933.
7. Davenport, C. B.: Body Build and Its Inheritance, Carnegie Inst. Wash. Pub., No. 329, 1923.
8. Dunn, L. C.: The Effect of Inbreeding on the Bones of the Fowl, Storrs Ag. Exp. Sta. Bull. 152, 1928.
9. Gates, R. R.: Heredity in Man, 1929, Macmillan Co.
10. Goldschmidt, R.: Physiological Genetics, 1938, McGraw-Hill Co.
11. Gowan, J. W.: Inheritance as It Affects Survival of Rats Fed a Diet Deficient in Vitamin D, Genetics **21**: 1, 1936.
12. Gottlieb, B., and Orban, B.: Die Vererbungen der Gewebe bie übermassiger Beanspruchung der Zähne, Leipzig, 1931, Geo. Thieme.

13. Green, C. V.: Size Inheritance and Growth in a Mouse Species Cross, J. Exper. Zoöl. **58**: 247, 1931.
14. Gregory, P. W., and Castle, W. E.: The Embryological Basis of Size Inheritance in the Rabbit, J. Exper. Zoöl. **59**: 199-212, 1931.
15. Grüneberg, H.: The Relation of Endogenous and Exogenous Factors in Bone and Tooth Development, J. Anat. **71**: 236, 1937.
16. Hirszfeld, H., Hirszfeld, L., and Brockman, H.: J. Immunol. **9**: 571, 1924.
17. Idem: Klin. Wchnschr. **3**: 1308, 1924.
18. Reed, S. C.: Harelip in the House Mouse, Genetics **21**: 339, 1936.
19. Sawin, P. B.: Preliminary Studies of Hereditary Variations in the Axial Skeleton of the Rabbit, Anat. Rec. **69**: 407, 1937.
20. Sharp, L. W.: Introduction to Cytology, 1934, McGraw-Hill Co.
21. Snyder, L. H.: The Principles of Genetics, 1935, D. C. Heath and Co.
22. Stockard, C. R.: Constitutional and Genetic Reactions Associated With Modifications of the Pituitary Gland, Proc. A. Res. in Nervous and Mental Disease **17**: 616, 1938.
23. Sumner, F. B.: The Partial Genetic Independence in Size of the Different Parts of the Body, Proc. Nat. Acad. Sc. **10**: 11, 1924.
24. Walter, H. E.: Genetics, 1938, Macmillan Co.
25. Wright, S.: General, Group and Specific Size Factors, Genetics **17**: 603, 1932.
26. Idem: On the Genetics of Subnormal Development of the Head of the Guinea Pig, Genetics **19**: 471, 1934.

DISCUSSION

Dr. Morris R. Lebow.—An attempt was made by Dr. Sawin to clear up and bring up to date the present knowledge resulting from various breeding experiments. In his own field, that of breeding experiments on rabbits, he has shown that the results obtained fell into line with the general and newer laws of heredity. There is, at present, no evidence to prove that man is the exception; these laws are equally applicable to him (man).

There are certain practical values in the study of heredity which we are apt to overlook. While orthodontists have been looking for an answer to their many problems, heredity as a causative factor in many dental and facial deviations has not been recognized. Our textbooks and authors, though recognizing in principle that deviations may occur from such a source, nevertheless failed to point out or to classify them.

To my knowledge, this is the first attempt to illustrate the practical value of taking the patient's pedigree along with the other data. In Figs. 10 and 11, you will notice the mandible and its dentition is larger than the maxilla (lower models, Fig. 11). This was first diagnosed as the failure of the maxilla to develop on account of premature loss of the temporary canines; but upon checking the family pedigree, we found a similar condition existing in the father (middle dentition, Figs. 10 and 11). His Pont index showed a plus 7 mm. in the premolar region and plus 12 mm. in the posterior region. A similar condition existed in the child's case. This led to the story as told by Dr. Sawin. Evidently a recessive trait made its appearance in this patient eight generations later.

As is well known, heredity and environment go hand and hand, and often it is difficult to recognize which is the cause. However, in this case, it is recognizable as the size of the jaws has been traced to inheritance. The effect of environment is recognized by the fact that although the maxilla is much smaller than the mandible, nevertheless, normal function caused the maxillary dentition to spread out fan-shape to meet its opposing and much larger mandibular dentition in normal relation. This indicated the successful effects of normal environment.

The second case mentioned by Dr. Sawin was that of four cousins whose fathers are brothers, (Fig. 12, *A* and *B*). All of them had similar Class II malocclusions. The treatment of the *A* group was simple, and no difficulty was experienced in bringing their dentition into normal occlusion. The contrary was true of the *B* group. At that time we used no pedigrees and were at loss for the reason and disappointed at our inability to develop their chins more prominently to match that of their cousins in the *A* group. After checking up on

their pedigree it became clear that the *A* group inherited their chins from the dominant side of the family (Fig. 13, left side of pedigree), whereas the *B* group inherited their chins from the recessive side of the family (Fig. 13, right side of pedigree).

The above is but a small example of the possible information one may obtain by using pedigree; such knowledge may help the practitioner avoid many pitfalls.

Dr. Lawrence W. Baker.—Noting that Prof. Sawin was going to speak on heredity, I could not resist bringing two or three slides with me. As these slides have a very direct bearing on heredity and its application to our field of endeavor, I should like the privilege of explaining them to you. These pertain to some of my transplanting embryonic bone experiments which form a part of my investigations on the growth of bones which concern us all—the bones of the face.

It may be that at first some of my practical friends here may regard what we are doing as a mere biologic "stunt." I believe, nevertheless, that Dr. Sawin will at once see its application to his field of study. He will realize, as I am sure you will later, that we

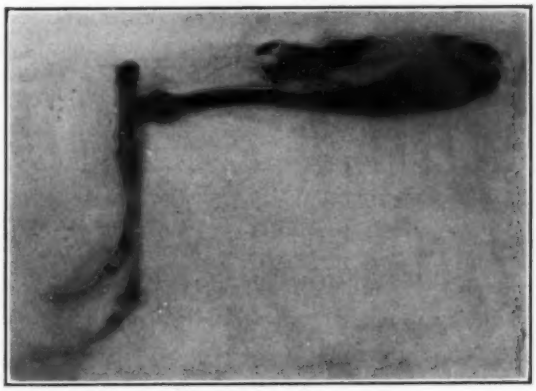


Fig. 1.

Fig. 2.

are separating, for study in isolation, the two great groups of influences which cause bone to grow. One of these growth factors is the prefunctional influences which are operative before the animal is born. The other group is functional and operates while the animal is living. It is the prefunctional influences which will interest Prof. Sawin as these factors are inherent in the bones themselves and come from the germ plasm. They are, therefore, inherited. The functional influences, operating as they do during life, come not from the genes but from muscular stimulation. They, therefore, have little to do with inheritance.

These two sets of forces we are studying in the following manner:

We transplant embryonic rat mandibles, the embryos themselves being taken from one horn of the uterus by a Caesarean operation, into the leg of the mother animal where they are allowed to develop for a definite time. (After much experimentation, we found that the most successful results were brought about by transplanting into the mother animal because of the close genetic relationship, and our most successful "takes" were obtained in a muscular environment.) These transplanted mandibles were compared with the mandibles of

those of the litter mates from the other horn of the uterus which were born normally and were allowed to live the same length of time that the transplanted mandibles were allowed to develop in the muscles of the mother's hind leg. Thus, we were able to separate the two great developmental forces of bone and study them separately.

In Fig. 1 is shown one of our successful "takes" at the peak of its development. As just pointed out, the bone was from one of those vital embryos taken from one horn of the uterus by a Caesarean operation and immediately transplanted into the mother's leg and allowed to remain there for forty days. The specimen was made transparent by a modification of the Schultze clearing method and shows that the actual pattern of the bone was formed prefunctionally by the developmental forces inherent in the bone itself.

It will be observed that the body of the bone and the ramus with its several processes have all taken definite shape. It is highly remarkable that so much of the form of this complex bone, which is developed from so many centers of ossification, should form without the intervention of nerve control or function. It is, indeed, a striking example of the genetic influences about which Prof. Sawin had so much to say.

Fig. 2 B is a close-up of the same transplant removed from the leg muscles and more clearly shows the bone pattern. In Fig. 2 A is seen the other lateral half of this same bone at the time of transplantation. It shows that the mandible at this time was by no means so well developed as now. It was scarcely larger than the point of a lead pencil.

Fig. 2 C is a photograph of the mandible of one of the litter mates which was born normally and allowed to live for forty days, the same length of time, of course, that the transplanted mandible was developing in the leg muscles. The illustration shows that the functional influence has continued the growth of the bone beyond that which was caused by the genetic influences inherent within the bone itself.

I sincerely hope that now my practical friends will not regard what we are doing as a mere biologic "stunt," but will appreciate that in these investigations we are studying the great influences which cause bone to grow.

THE TREND OF CLINICAL ORTHODONTICS

PART I

LEUMAN M. WAUGH, D.D.S., F.A.C.D.,* NEW YORK, N. Y.

FOR the last three or four years members of the Program Committee have importuned me to present something on a clinical phase in orthodontics; consequently some little time ago in the spring I said that I would be willing to give an informal talk on this topic, presenting the problem as I see it from experience in practice and from our experience in the clinic.

I know I shall say things that will cause disagreement on the part of practically every one of my friends in the room whose opinion I respect most, but in an effort to reduce technique to the simple procedure and yet employ efficient methods of bringing about in the best possible way the results that we desire, I shall give you an honest opinion of our problem just as I see it today from an effort being made to simplify our treatment, to make it more direct and more positive, and especially to reduce the period of time that the patient is required to wear orthodontic appliances. By this I do not mean that we reduce the total observation and treatment time so much but the actual period in which appliances are worn. We must meet the criticism that is directed toward us of putting appliances into the mouth of almost every patient that is referred to us and keeping them there for from two to ten or twelve years. Such has sometimes been the procedure in years past. I feel that we then had altogether failed to recognize the fact that nature itself is doing so much to grow a head and a face and build a denture.

I shall say nothing this morning that is new. I shall hope to review and direct attention to those things which it seems to me are of utmost benefit to us in clinical orthodontics. I shall stress more some of the important practical applications of underlying science.

In our definition of orthodontics, I like best that of the British Society of Orthodontists. Our conventional definition is that "orthodontics is that branch of science which treats of the prevention and correction of malocclusion of the teeth." It is that, but I think a better comprehension is obtained by a few more words, such as are used in the British definition, which is: "Orthodontics includes the study of the growth and development of the jaws and face particularly, and the body generally, as influencing the position of the teeth, the study of the action and reaction of internal and external influences on this development, and finally the prevention and correction of arrested and perverted development." Growth is the thing we must bear in mind, and we continue to find more growth in nature as our researchers make progress in their work.

Presented before the New York Society of Orthodontists, New York, N. Y., Nov. 15, 1937.
*Professor and Director of Orthodontics, Columbia University.

The first slide* has been prepared for the purpose of illustrating the biologic concept of growth oriented to the development of occlusion from conception to maturity. The periods of accelerated horizontal growth were determined by T. Wingate Todd. The period of most rapid horizontal growth is from the twenty-first day after birth to the seventh month, at which time the first of the deciduous teeth usually erupts; the second most rapid period is from the fourth to the seventh year, and the third is from the sixteenth to the nineteenth year. The scheme was suggested by Harry Wright, who adopted it from an illustration used in physiology by Professor Ludholz. A somewhat similar chart was published four years ago. This illustration has recently been prepared in its present form and is used to describe what, to me, is the orthodontic ideal in diagnosis and principle of treatment. I believe the more nearly our knowledge and skill permit us to attain this, the better will be the quality of our service.

On the left in Fig. 1 the male and female pronuclei are represented by two black dots. These fuse to form the fecundated ovum. Heredity is sealed when this has taken place. All that is given us by ancestors is herein contained. Development is the expression of the genes contributed by both parents. This affects the face, jaws, and teeth as it does all parts of the body. It seem reasonable to assume that, if there could be no retarding environmental influences from fertilization to maturity, the face, jaws, and occlusion would attain full possibilities and be predetermined by the heredity of each individual. This does not imply, however, that it would be a normal face or jaw or a normal occlusion. It would, in fact, frequently result in malocclusion with malformed jaws, face, and body. This cause is responsible for the most obscure and extreme cases which are so difficult to treat successfully. Environmental influences, however, may be said to exert invariably an influence at some time during the developmental period, and these should be promptly recognized and overcome.

That there are periods of comparatively rapid and slow jaw growth has been convincingly shown by Todd. There are actively growing in the jaws at birth, twenty-four tooth follicles, twenty for the deciduous teeth and four for the permanent first molars. The first of the deciduous teeth to erupt is the mandibular central incisor at about the seventh month after birth.

There follows a period of slower horizontal growth, with vertical growth going on as the teeth successively erupt and grow vertically to the line of occlusion. At this early age the services of the orthodontist are very seldom sought. There are two considerations, however, that should concern him. First, that the gymnastics of natural suckling be instituted, should the infant be partly or wholly bottle fed. The mother should be urged to use an artificial feeding nipple that will compel the movements and effort of the involved musculature that would be exercised in natural feeding. And, second, the mother and the nurse should be warned against the practice of nudging the infant on the point of the chin to waken it. We fear that this practice,

*The slides shown at this meeting have been published; therefore they are not included in this article.

if continued, may influence detrimentally the growth and position of the mandible by tending to produce distal position of the mandible.

The second period of most rapid horizontal growth is from the fourth to the seventh year. This is a most important age range from the standpoint of the orthodontist, for at this time decisions of great importance must very often be made.

There are in the jaws more teeth and follicles than at any other time in life. There are twenty deciduous teeth completely formed and in occlusion, and in addition there are the actively growing follicles of twenty-four permanent teeth, making a total of forty-four teeth and follicles. Little wonder, then, that developmental spacing is frequently disturbed. The knowledge and skill of both the orthodontist and the dentist are given their severest test during this transitional period from deciduous to permanent dentition. The dentist is called upon to do proper restorative work for children, including properly contoured fillings and placement of space retainers when teeth are prematurely lost, and also to refer patients when jaw development and growth do not take place properly. The orthodontist is called upon for best judgment as to when and how the necessary treatment is to be given.

The third period of most rapid horizontal jaw growth is from the sixteenth to the nineteenth year. At this time there are the four follicles of the third molars, with full size crowns, obeying the developmental urge to erupt. Additional horizontal jaw area must be grown if they are to find normal positions. This is frequently a period of keen anxiety for the orthodontist and of disappointment for the patient. The oral surgeon is often needed to prevent failure of an otherwise successful treatment.

Knowing the average normal periods or ranges of jaw growth and tooth eruption, the orthodontist should be in a position to compare the mouth condition with that of the body in general and be able to decide whether all is progressing properly. If not, procedures should be instituted to stimulate mouth and tooth growth into harmony with that of the body as a whole. This accomplished, he should give nature a chance, carefully observing what is taking place. Should it continue, no further active treatment will be indicated. If, however, there is another lag, active treatment is called for. In this way the patient is under orthodontic care during the developmental age but is required to undergo appliance treatment only during periods when it is necessary. To explain in popular language, there is a predetermined highway from fertilization to the completed dentition. Only when growth and development detour from this highway is orthodontic assistance called for, and as soon as the malgrowth is guided back on to the highway, step aside and let nature take its course, but be systematically on the outlook for another detour. Should it occur, then repeat until maturity is attained. Thus should the normal be brought about for each individual, by the simplest possible treatment and the least wearing of appliances.

Some of this may seem rather too rudimentary, but I do feel that we may remind ourselves of it to advantage occasionally. Galton's law of bisexual parentage, I think, is now rather generally accepted, although I know that all of us older members recall that not over fifteen years ago we had long, drawn-

out battles before this Society as to whether or not heredity had any influence at all on the growing of a denture. Today, I believe every one of us recognizes that it does have an influence. According to Galton's law, we find that any organism of bisexual parentage derives its inherited characteristics about one-half from its parents, one-fourth from its grandparents, one-eighth from its great-grandparents, and one-sixteenth from its great-great-grandparents, and so on, and this influence of inheritance has been referred to as "the eternal residuum of life." This problem complicates the orthodontic problem, especially where we have a community, as we do here in New York and in most of the United States, of such an admixture of races, where hereditary peculiarities may be recessive in one generation and dominant in another, so that it is more difficult for us from the history and from the physiognomies and statures of the parents of our little patients to predetermine what type we may expect in them.

At the fourth fetal month, the seventeenth or the eighteenth week of fetal life, just about the time the obstetrician begins to feel certain of the mother's condition, we find that the jaws have so far developed that in the mandible the follicles are appearing for all of the deciduous teeth. Now, I am not saying that these are calcified. The central and lateral incisors and premolars have their tips calcified at the seventeenth week. Not all of these show calcification, but the matrix is being laid down as early as the fourth fetal month, in both the maxilla and the mandible. We must, indeed, be impressed by the fact that nutrition during the period of gestation is an important factor in the development of the dentition; therefore, the orthodontic problem really might be said to begin with conception.

At the fortieth week, or at birth, we find calcified in the jaw the twenty deciduous teeth in that tiny mandible and maxilla. We also find the permanent first molars nicely laid down, and in some cases at least calcification of the tips of the cusps of the permanent first molars has begun. So in the jaws at birth there are the follicles for twenty-four teeth, twenty deciduous and four permanent. Is it any wonder, then, that Todd is correct in the statement that the period of most rapid horizontal growth of the jaws is from the twenty-first day after birth until the seventh month after birth? That is a period when the orthodontist is not called into the case at all. That is a period when the child specialist in medicine, the pediatrician, is looking after the welfare of the little one. Remember the whole growth of the individual reflects itself in the growth of the jaws as later the jaws and their teeth will have an important influence on the nutrition and welfare of the whole body.

Three months after birth, we find in addition to the twenty deciduous teeth and the four permanent first molars, follicles for the central and lateral incisors and canines of the permanent set and just the beginning of little buds for the first and second premolars. You see how fast even three months after birth these follicles are building up. Is it any wonder then that infants at this age experience considerable reaction from the rapid changes which are taking place in the jaw? The most rapid horizontal growth is from the twenty-first day after birth until the seventh month. Then at the seventh

month, of course, we have an important mile post in the dentition in that the first of the deciduous incisors, the lower central, shows through the gum. From the seventh month on, Todd tells us that, until about the fourth year, there is a period when horizontal growth in the jaw is comparatively retarded. However, vertical growth is accelerated, but some horizontal growth is taking place. As we see these follicles unfold, remembering how many of them are growing, it makes us realize that progress in dentition is very active during this period. This is the preorthodontic age, of course.

At two and one-half to three years of age all of the deciduous teeth have erupted and in most cases are in the occlusal plane contacting their antagonists. We see how very large the head, in general, is compared with the face, which is the part from the top of the orbit down. One can see how very large that is, yet there has been a great deal of growth up to this point. I might emphasize the relationship here of the distal sides of these second deciduous molars and their relationship upon the proper direction of the permanent first molars so that they, as the cusps come into contact, will be within the influence of the proper inclined planes, but that is, perhaps, too elementary. However, it is important that the mesiodistal relationship of these second deciduous molars and the permanent first molars be maintained fully so that when the permanent first molars shall erupt and come up into occlusion their cusps will be within the influence of the proper inclined planes. So important are they in maintaining the relationship of the mandible to the maxilla that here is a real crucial point in preventive malocclusion. A little later I shall stress my belief that preventive malocclusion belongs distinctly to the general practitioner of dentistry.

The relative proportion of the face and the cranium is an interesting thing for us to consider as orthodontists. We should not mistakenly take credit for a good deal of the growth and the changes that just naturally take place. At birth the face is in the proportion of one part to eight parts of the cranium, or making it one-ninth of the head size. Then at the second year the proportion has changed considerably. Even though the head continues to grow quite rapidly, we still find that in the oral or dental area, the face has grown faster than the rest of the head, so that the proportion is increased to one part to six, or one-seventh of the head size; at the fifth year it has become one part to four, or one-fifth of the head size; and at ten years it has become one-fourth. At maturity we have two parts cranium and one part face entering into the head proportion. That growth, if it is normal, takes place without us. I think it should make us pause at times when we are deciding to put appliances into a mouth where it may be a question as to whether it might not be much better off without appliances; at least, our appliances should be chosen and placed in a manner that will restrain in minimal degree the directional tendency in growth of the jaws and of the teeth.

At four years the deciduous denture is complete. By "complete" I mean the root ends are complete in the average child. At two and one-half to three years, the crowns are erupted, and at about three come into occlusal contact, but the root ends are not fully formed, so we do not speak of it as a "com-

pleted" denture. At this point, four years of age, the small growing jaw has twenty deciduous teeth erupted, four permanent teeth nearly ready to erupt, and twenty more permanent tooth follicles growing in the jaw, so that at from four to five years of age forty-four teeth and tooth follicles have either erupted or are growing in the jaw.

In growth a change takes place. As shown in this skull, the crowns in the follicles of the larger permanent successors of the incisors are lying close to their roots. No resorption has as yet occurred. The crowns of the teeth, after they begin to form, very soon take their full width. So, the urge of the growth of these teeth and the general tendency to a growth of the head, especially of the face, brings about a spacing between the maxillary and mandibular deciduous incisors in most cases when growth is normal. Some such spacing must take place if the permanent teeth are to come into their proper places soon after they are erupted. We can see here that the lateral incisor follicles are quite to the lingual of the central incisors, the canines are fairly close, by that we do not mean that we must have sufficient area here at this time for those teeth immediately upon eruption to come down into the line of the curve of the arch in the anterior segment. The lateral incisors above and below occupy a somewhat lingual position, often come through slightly to the lingual, and then as a result of growth and perhaps as the result of the functional action of the tongue in speech, deglutition and other movements, tend to carry the lateral incisors forward, so they may come into place as natural growth of the jaw takes place.

Whenever we find that no developmental spacing occurs, while it may not indicate positively that there will be a lack of alignment in the anterior teeth, I do feel that we are safe in assuming that when there is no developmental spacing of the incisors, it is a case that must be cautiously watched, and that there is present a tendency toward a malocclusion in the anterior part of the mouth. The parent should be informed of the condition and urged to see that thorough mastication of resistant foods and perhaps artificial exercises are used regularly.

A child was brought to the clinic by the mother who was terribly distressed because the deciduous anterior teeth which had been so close and beautiful were beginning to space and look very ugly. She wanted us to move all the teeth close together. When I told her this was the normal and that this child would probably never require orthodontic assistance, she looked skeptical but on my assurance was content to do nothing about appliances at once. However, as the case developed, and we followed it, we were correct. The orthodontist was not needed in aiding the permanent teeth to come into their proper places in the arch. Nature did it unaided.

In another case the lateral incisor crowns tipped away from the median line. The positions of the crowns of the canines pressed on the distal side of the root ends of the lateral incisors. This and the flaring of lateral and sometimes of central incisors is normal at this particular stage of growth. If we will let them alone as the canine crowns grow occlusalward into place, they will press on the distal sides of the crowns and automatically close the spaces.

You see I am trying to bring out the fact that we are making an effort to let nature do all that she will under our observation before we resort to appliance therapy. Often she can do better, much better, than we can do.

Again, we see a case in which the canines are in place, and the central and lateral incisors have come more or less into normal proximal relationships.

The orthodontic problem I feel may conveniently be considered under four divisions:

1. Preventive malocclusion or prevention in orthodontics.
2. Corrective orthodontics.
3. Post-treatment observation.
4. Tooth positioning for adults.

I would not call this fourth division true orthodontics. It is mostly the positioning of remaining teeth to improve occlusion and help the prosthetist to get a more esthetic result and a better occlusion with his artificial restorations.

Preventive malocclusion in orthodontics I feel is strictly the work of the general practitioner in dentistry, and that is what I think the colleges should try to teach their undergraduate students. That is all I think there is time for in the crowded undergraduate curriculum. I have taken a poll of my classes for fifteen years, and in no class did more than 14 per cent of the seniors want clinical orthodontics. The poll ranged from 14 per cent down to 6 per cent. There is an overwhelming percentage of students who do not want to treat malocclusion. There is not time for them to finish the patients that they begin, so they cannot see the end results of their effort, and a little knowledge might serve only to give them a sense of false security in practice. We have, however, time to give the undergraduate a good course in preventive malocclusion or prevention in orthodontics. We emphasize to the students that if they will apply what we teach them in preventive malocclusion, they can do a great humanitarian service and can prevent from 35 to 50 per cent of the need for complicated corrective treatment. I feel that this, by and large, is preparing them for a much greater service to their patients than to be limited to giving them a smattering of instruction in corrective treatment.

Corrective orthodontics is the work of the specialist, preferably the exclusive practitioner of orthodontics. Progress in orthodontics in America has outdistanced that of any other nation because there have been specialists, exclusive specialists, who have given themselves wholly to this task, have brought in a great deal from collateral science that is valuable to us, have stimulated researchers like T. Wingate Todd, Sir Arthur Keith, Alex Hrdlicka, William Gregory, B. Holly Broadbent, Milo Hellman, Samuel Lewis, and others in our own group and in collateral sciences to contribute to our knowledge of normal growth processes. It is this concentrated effort that has brought orthodontics to its present state of advance. It could not have been done except by those who have and are giving the best of their all in effort and in time to this work.

Post-treatment observation may well be a divided effort. Soon after the treatment is completed, it is mostly, I believe, the duty of the orthodontist to have the patient return so that he may observe the postoperative stability of the work he has done. We do not want to keep our patients coming back to us all of the time, so gradually it should be taken over by the dentist. I think those of us in orthodontics who contact the dentists who send patients to us should make them feel that we expect them to know and to do quite a little about this. It compliments them; it informs them; and, I believe, it is a type of instruction that will make the thoughtful practitioner feel more kindly toward us as specialists—goodness knows we need that today as we have never needed it before—and it will work for the welfare of the patient.

As to *tooth positioning,* I do not know why the general practitioner cannot undertake to do that: to simply put in an appliance and change the axial inclination of a few teeth is not exacting in most cases. Most of this can be done by the general practitioner, and I always like to cooperate with him if he so wishes. I always like to suggest, "Wouldn't you like to do this yourself? There is no reason why you cannot do it if you want to. If you wish me to help you as to the planning of treatment and deciding on the type of appliance and its manipulation, I shall be glad to cooperate with you at any time and tell you my procedure were I treating the case in my office. If you want to do this in your office, well and good."

Orthodontic treatment I like to consider under seven headings: First, *physiologic,* like thorough use in mastication, speech, deglutition, and breathing. Second, *psychologic,* as in habit breaking, and as in the observance and the teaching of the proper use of muscles. Children maluse muscles so much that I think we are just awakening to the importance of watching this angle. We have talked about it; I have read papers about it that were written as I was coming into orthodontics a quarter of a century ago, but it has not impressed itself upon us sufficiently. I think it is one of the most important things for us to watch in preventive orthodontics and also during corrective treatment, and especially in diagnosis and the outlining of treatment. Third, by the use of *exercisers* as the bite strap or odontobel, and by thorough chewing of food, which is so stimulating in aiding growth during this very active growing and developmental period. Fourth, *myofunctional therapy,* which we have found to be very helpful. Fifth, *medical aid,* which we need a great deal more than most of us realize. We need the pediatrician so often in cases that do not seem to be responding to our efforts or to ordinary orthodontic treatment, or perhaps not responding as well as in a similar treatment even with a twin brother or sister. The pediatrician then, in such cases, can usually suggest something that will help out. Also the rhinologist is needed. When we consider that in the embryonic stage the stomodeum is the great cavity in which both the nose and the mouth are formed from the same tissues, blood supply, and the same nerve control, we must not lose sight of the intimacy of that relationship, as we are working with the patient. Sixth, *surgical aid* in the removal of supernumerary teeth, exposure of impactions, cleft palate and cleft lip. Seventh, finally after everything else has been attempted to overcome the

condition we must resort to *appliance therapy*. I shall speak of appliance therapy a little later.

Strong muscles are a great factor in developing large, well-formed jaws. A good deal has been said about the influence of muscular action, pro and con, and a good deal has been said about the strength of jaws, pro and con. One writer, not a dentist, of international reputation as an authority on the lore of the Eskimo has been writing and saying during the last two years that the dentists are all wrong, that the Eskimo just inherits his large, strong jaws, and that the chewing of food has nothing to do with it.

In Table I is shown the comparison of the biting strength of trained athletes in a university and the Eskimos.

TABLE I

AVERAGE BITING STRENGTH

SEX	NUMBER	AGE* (YR.)	WEIGHT (LB.)	HEIGHT (IN.)	BITE (LB.)	STRONGEST BITE (LB.)
Primitive Alaskan Eskimos Tundra Villages of the Yukon-Kuskokwim Delta and Adjacent Islands						
Males	55	35	127	63.84	297	345
Females	22	27	128	60.15	260	310
Football Squad†						
Males	108	21	176	72.00	126	180

*Age range 16 to 55 years—estimated.
†University of Minnesota, 1936 (Brekhus-Armstrong).

A little Eskimo girl, 8 years old, bit 14 pounds more than the most powerful athlete on the team weighing over two hundred and thirty pounds, twenty-one years old, and over six feet four inches in height. You cannot convince me that the rugged use of those teeth has nothing to do with the strength of the jaws. If that is true with the Eskimo, it must be true with our children, and the work of Dr. Rogers must be regarded as valuable to us. We must urge our patients, we must have our own children chew things that are resistant, and nothing is much more resistant than a saliva-moistened crust of bread of the hearth baked type. Take some rye bread, Vienna bread, or Italian bread, take the crust into your mouth and let it moisten in the saliva, chew it, and reduce it finely, and see how much strength it takes. Consequently, we must teach youngsters if they want large, strong jaws, they must exercise them, just as we teach them to exercise their arms, their legs, and other parts of the body. That is a factor in reducing the amount of appliance therapy needed.

The requirements for orthodontic diagnosis and classification are the following: First, personal examination of the patient. You cannot send a cast or an impression to a laboratory and have them diagnose the case and plan treatment. A personal examination of the patient, to me, is essential. The picture of a child walking into the operating room, his reaction to the questions that I ask, his standing in school for his age, as well as other things that can be detected only by personal examination, are most important. Second, history as complete as possible. Third, thorough check-up of nasal region and air passages. Fourth, complete set of radiograms, intraoral and,

when indicated, extraoral. Fifth, casts of the mouth from accurate impressions. Sixth, gnathostatic photos. We have had some very extreme opinions expressed here within the last four or five years about gnathostatics. We have used the method with much satisfaction. Unrelated photos are not sufficient we feel. Seventh, graphs or plane reproductions. These are very valuable. One may use the Simon method, or one may do this with the orthodontoscope, or by a combination.

Gnathostatic photographs. The Frankfort horizontal oriented, the outlines of the various landmarks of the mandible, its position to the head taken as a whole, are the main things in our diagnosis. It is not the position of the permanent first molars only; it is the position of the mandible and its relationship to the cranium taken as a whole. Drawing it out in this way helps. Do not think that we believe that just one standard of face is the ideal. We always try to recognize the individual normal; and don't think that any one of us believes that a machine can tell us just when and how we shall treat. It is just a help, but a better help than anything else we have used. There is always the human element. There is always a chance for error in making the photographs. There is a chance for error in everything we do. The degree of near perfection depends on the ability of the individual to approach it, but the possibility is there.

And then we believe, emphatically, in having our casts oriented with some fixed plane, as nearly fixed as any plane is in the growing head. Anthropologists have told us for a long time that the Frankfort horizontal is the most fixed plane. Broadbent and Todd have shown us that the sella turcica is the most constant part and have established the Bolton plane and consider it better. I think, perhaps, it will be found the better; however, either is a sufficiently close guide for clinical purposes to let us know the orientation of the casts to the cranium, and, what is still more valuable, to let us know through the years, as we treat our cases and make successive sets of casts by this method, the growth tendency and the changes that we have been able to bring about. In this slide are the casts of a senior student in our class. I might have called your attention, as I do the undergraduate students, to fixing in your mind the kind of a dentition that face would have. A good many of them thought it would be a Class II malocclusion. No one would suspect such a near perfect set of teeth. See how the plane descends here in his face. It is very nicely set in his head, but any of you who have examined any number of casts have found they are not symmetrical from the median line of the head at all; they are in all sorts of positions in relationship to the cranium, meaning that excursions of the mandible have an effect on the teeth of one side different from what the effect would be on the teeth of the other side if they were in central position. This is as nearly a perfect mouth as I have ever found; it is a superlatively fine set of teeth.

Case analysis. This I think is the crux of our situation. All through the years we have been endeavoring in our work to have some set means of analyzing and writing out conditions as we find them. With our students at school we have quite an elaborate analysis. This is the one that Dr. Strang

uses. For those who do not want to follow gnathostatics, we strongly recommend it. The Angle classification is used. It is determined under six headings: First, the inclined plane relationship is studied; second, the axial inclination is taken, and I think we have been very remiss in not putting sufficient emphasis on the axial inclination of teeth in making our diagnosis and our case analysis. Many of the cases that we have treated in earlier practice as Class II cases I think would have been nicely diagnosed as Class I with the buccal segments on one or both sides of one or both jaws moved to the mesial, had we followed and studied the axial inclination of the teeth, more especially of the canine teeth. Third, radiograms showing supernumerary, missing, malformed teeth. Fourth, molar rotation whereby the length of the dental arch is increased. Fifth, the median line is an important factor; and then the importance of photograms and I emphasize those accurately oriented are the best.

I want to say a word about mechanical therapy. As I said, we have been striving for a simple means whenever adequate. I shall discuss the lingual arch, the plain labial arch, and then a type of arch by which one can bring about individual tooth movement to best advantage. For a time we were working generally with the excellent mechanism given us by Dr. Mershon in the lingual arch, and we have had so much satisfaction in the use of the lingual arch that we feel that—and it is not wise to prophesy—the lingual arch will always form a most important appliance in our hands. It does the work intended for it so satisfactorily. It has the least restraining influence against the tendency of nature's directional growth of any appliance that we have, and for the production of lateral growth of the buccal segments of the jaw, I cannot conceive of an appliance that would work so nicely and be so congenial to the growth of the tissues. I have worked for quite a time with the lingual arch in aligning anterior teeth and bringing about other changes in the mouth, and, while I have had partial success, I have not been able to handle it as well as others of you, including Dr. Mershon, in the alignment and rotation of anterior teeth. Consequently during the last six or seven years, more and more for simple alignments and simple rotation in the anterior segment, we have used a labial arch mostly .030 and smaller. The plain labial arch, like the lingual, can be augmented considerably in its efficiency by attaching auxiliary springs, not of all types and all forms, but simply small more or less direct springs. For this we prefer an .036 arch for the attachment of auxiliary springs.

Bite plates after the Hawley type have formed a real part in practice, for when we want to correct supraocclusion, of the lower anterior teeth especially, nothing has given us as satisfactory results as the bite plate. We shall continue to use it both with an incline to the plane and in other cases with just a flat surface to the plane.

Perhaps you also know of the molar bite plate; where it is indicated we have had considerable success. Dr. Ralph Eaton, a former associate of mine in practice, prepared a clinic on this for us five or six years ago. It was presented at the meeting of the American Society of Orthodontists. I have used

it in practice, and we have used some of them in the clinic. Where we have the anterior teeth in open-bite and where we know that the molars are in supraocclusion, it has been most difficult for us to have an appliance that would tend to depress them. Dr. Eaton built, what we chose to name for him, a molar bite plate, a vulcanite block which fits over the occlusal surface of the mandibular molars, either with a vulcanite attachment across the front or a metal attachment. This is worn by the patient, and, when in the mouth, the molars occlude before the normal, which tends to, and in some cases does, beautifully depress the molars, bringing the anterior teeth to a point of proper closure of the mouth. If then the habit which originally caused this can be overcome, the result remains. It is a help for conditions that I would have considered hopeless until I saw this appliance. I urge you to look into the molar bite plate for your cases in which the molars are in supraocclusion. All open-bite cases are not of that class. The diagnosis is important.

The labial and lingual arches and the bite plates bring about correction in a large percentage of our cases. There is, however, a percentage that requires a more exacting technique. Some of my friends in this room believe that the root ends of a tooth should never be moved. I cannot agree with that. I do not think I would like to compromise my principles quite so much as that, which perhaps proves that I am again wrong, but I am telling you just as we see it. We have felt the need for an appliance through the years that will bring about a bodily movement of teeth. Twenty-five years ago Dr. Angle and his group gave us the pin and tube. Eagerly I took it on feeling that the big problems of orthodontics were about to be pretty well solved, and it did a great deal for us that we had never before then been able to achieve. Then he simplified that and gave us the ribbon arch. That was much simpler in its technique, and when properly handled did beautiful work, better than we had ever been able to do before. (When I say "we," I mean orthodontists.) After the work of Dr. Ketcham with root end resorptions as the result of the use of the ribbon arch, I gradually discontinued the use of those appliances except for occasional cases, where there was a tooth that tipped a lot buccally or lingually. I had felt more and more there must be an appliance which would safely, more positively, and more easily than did the ribbon arch, permit us to bring about changes in the axial inclinations of teeth and to bring about other changes which we found desirable and which we could not bring about satisfactorily with the lingual and plain labial arch. Consequently during the last four years we have been watching a group of patients in the clinic who are being treated by the edgewise mechanism. I have been more and more delighted, and many times astonished at the very fine results obtained in a very short time, without pain, and in most instances, without apparent damage to the structures by the use of that appliance. Personally, therefore, I am glad to recommend it. I have recently taken the course under the direction of Dr. Strang and am taking up that technique just as he teaches it. We are taking it up in its pure form, and we are not trying to modernize or improve it, at least until we have mastered it in the form that it was given to us by those who have so cautiously worked it out through the years. I am hopeful that with that appliance we are going to be able to make those finer

adjustments in the cases requiring it that I personally was not able to do with the other appliances, changes that I know are desirable and that I believe can be made without harm if carefully done.

I was impressed with the fact that Dr. Strang and the Angle group are making their appliance less fixed. They are not using the edgewise arch in its full size to fit snugly into the brackets in all cases. They are doing a great deal, at least of their preliminary work, with rounded wire that does not fit snugly into the arch, giving considerable play, and only as they approach the near completion of their cases do they begin, in many instances, to use the edgewise for that final alignment that they desire.

I feel that those of us who are so satisfied with the work that we are accomplishing with other appliances will never want to use this as the only appliance in our practices. I know that I shall not, but I know that in a percentage of cases I shall learn to use it with utmost satisfaction. I think that those who do not use it are going to see their more progressive neighbors get finer results in a shorter time by appliance therapy in many cases than they can get in any other way.

Part II will appear in the June issue.

FRACTURES OF THE BONES OF THE FACE

JAMES BARRETT BROWN, M.D., F.A.C.S., ST. LOUIS, MO.

FACTORS of importance in extensive facial injuries may be listed as follows: (1) When a patient is examined, following a severe blow about the face, it is best to suspect a fracture and work from that point. If it is assumed that the possibility of fracture can be considered when the swelling has gone down, or, if soft tissue repairs are carried out with disregard for displaced bone fragments, the best chance for correct bone replacement has been missed. (2) Possibilities of good repair are present in almost all instances but must be met promptly and adequately. (3) Simple procedures of accurate replacement and holding of bone and soft parts, drainage and bandaging, should suffice; and, with relatively simple equipment, sound care usually can be afforded these patients. (4) The reverse is true if the full picture is not clear to those in charge and restorative measures are lax. (5) Although the lesions may be multiple, complicated splints and traction are seldom required and may actually be detrimental in some instances. It is important, however, to have available someone cognizant of the dental requirements and means of fixation, because one of the most important functions to be preserved is that of mastication, and this requires that the teeth come together in normal occlusion. (6) The problems presented by fractures about the upper part of the face require careful evaluation, and diagnosis; if tissue has been completely lost, this point is of extreme importance in the final outcome, and the extent of loss should be recorded either in the original examination or at the time of operation. (7) Skull fracture and brain injury are so frequent that neurologic examination, including x-ray films, often must be made, and local repair delayed if there is any lesion that requires treatment or complete rest. Patients who receive "snap" blows about the head may have damage to the cervical spine and, on the slightest indication, this region also should be checked with the x-ray. (8) Ocular damage is very frequent and is often the main indication for treatment. (9) Although good position and function may be obtained, final bony union may never occur in many instances. This may be due to the very thin edges of bone, that simply do not unite, and also to prolonged infection. In the lower jaw there may be solid union but with persistence of the fracture line on x-ray.

ASSOCIATION OF BONE AND SOFT TISSUE DAMAGE IN COMPOUND INJURIES OF THE FACE

The lacerations, avulsions, and tears of the soft parts, and the fractures and displacements of the bones may be so numerous that it may be difficult to list all the diagnoses, and the term, "compound injury of the face," could be used

From the Department of Surgery, Washington University School of Medicine.

Read at the Thirty-Seventh Annual Meeting of the American Association of Orthodontists, Kansas City, Mo., April, 1939.

Republished by courtesy of Surgery, Gynecology and Obstetrics. Feb. 15, 1939, 68: 564-573.

as a rough classification. Although widespread soft tissue damage often occurs without fracture, and very extensive comminuted fractures result from blunt force, which may not even break the skin, the two occur together so frequently that it is not possible to separate completely the repair work of bone and soft tissue.

X-RAY EXAMINATION

It is not necessary to rush these patients to the x-ray room, because most operative procedures can be done without the pictures, and the necessary manipulation in the x-ray room might be contraindicated if there were skull or cervical spine damage. However, when safe for the patient, complete views of all involved regions should be taken.

In roentgenograms of the upper jaw the heavy ridges of bone show quite well in antral and in verticosubmental positions, but there may be many comminutions of the maxilla, ethmoid, nasal, and other thin bones that are entirely missed on the x-ray plate and, therefore, this condition has to be searched for at the time of operation. Complete skull and cervical spine series should be taken as indicated before. For the lower jaw complete views of both sides, including both condyles, should always be taken, because multiple fractures may be missed even at operation. The laminograph, developed by Dr. Sherwood Moore and designated as body section radiography, gives the most accurate information of the joint area.

PRIMARY REPAIR TO BE DONE EARLY IF POSSIBLE

These wounds and fractures should be cared for in the first twenty hours if possible, before excessive swelling, organization of clots, and infection have occurred. This necessitates work at odd hours of the day and night, and it is recognized that the statement has been made frequently that the repair of facial injuries should be delayed several days. If the patient is seen after this time and there would be the necessity of manipulation through contaminated clots and edematous tissue, the replacement of bone might be delayed until there is subsidence of the swelling, although the soft parts might still be approximated. The replacement of bone fragments should not be delayed longer than seven to ten days under nearly all circumstances because the fixation of small, comminuted chips after this time may make impossible their correct alignment.

Shock and neurologic damage may necessitate delay in early repair; and, if a patient is intoxicated, the jaws should not be wired together.

GENERAL CONSIDERATIONS OF THE OPERATIVE PROCEDURES

It may be best to wait until the patient is in the operating room before any manipulation is done, so that there will be the least discomfort. Then a complete analysis should be made of what is necessary in order to carry the repair, in definite steps, to completion. For example, the patient in Fig. 1 was so uncomfortable because of a symphysis fracture that this was fastened together first, by drilling and direct fixation of the fragments. He was immediately more comfortable, and then the repair of the floor of the mouth, chin and lip was completed. Next, the upper part of the face, nose, ear, eyelid, and scalp were repaired; and by using clean instruments, gloves, and drapes throughout, there was no further mouth contamination.

Anesthesia is usually obtained with novocain, locally, or by deep block of the second and third division of the fifth nerve. A basal drug can also be given, but general anesthesia should be avoided, except that it is necessary when dealing with children.

Fig. 1.—*a*, Extremely widespread soft tissue injury plus complete separation through the symphysis. *b* and *c*, Complete restoration in one operation which was done a few hours after the accident.

DÉBRIDEMENT AND PRESERVATION OF TISSUE

Cleaning of these facial wounds is extremely important and should be done with soap and water followed by ether and saline irrigations so that local antiseptics are seldom necessary; anesthesia may have to be given before the cleaning is completed because of pain. Oil ground into the face should be scrubbed and dissolved out completely. Bits of glass from rear vision mirrors or from completely broken shatterproof glass are especially apt to be overlooked, and

for this reason it is well, if possible, to find out whether or not any glass was broken at the time of the accident so that search may be made accordingly.

Débridement should be done very sparingly both of soft parts and bone. If the usual idea of wide excision of torn edges were applied, many parts of

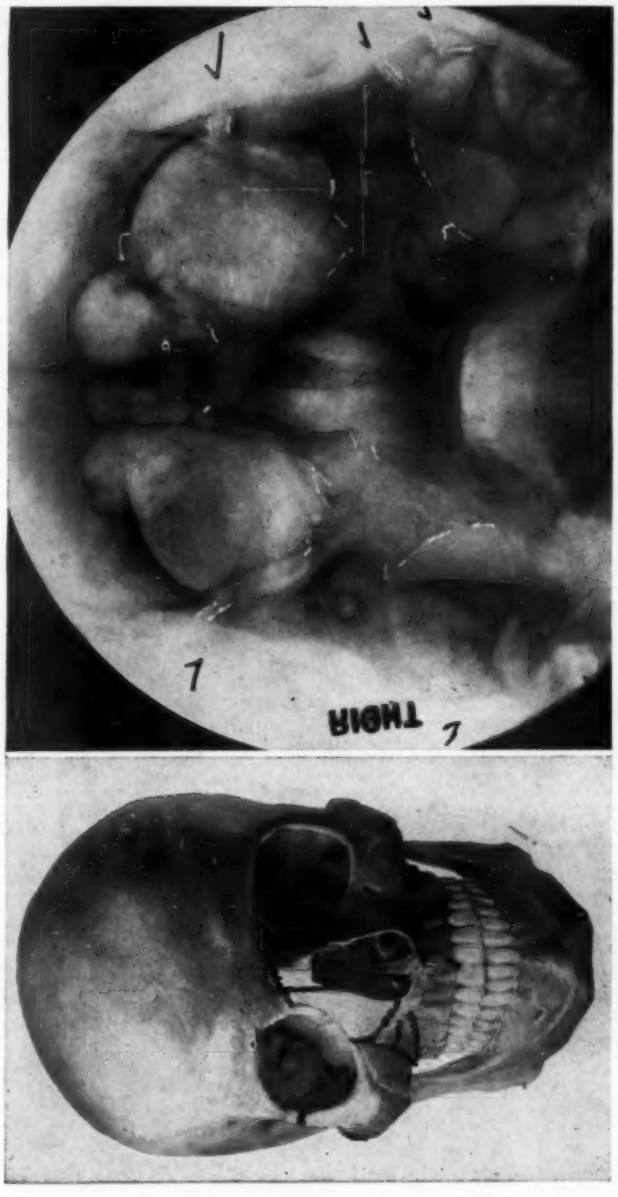


Fig. 2.—*a*, Diagram of frequent separations of the upper jaw, to which should be added a loosening all the way around on both sides just above the alveolus. *b*, Multiple comminutions of the facial bones, some of the areas having been scratched in for clearness. Separation of the zygomatic-frontal suture lines on both sides crumpling of the zygomatic arches, and commination about the orbital borders and antrum.

features would be needlessly sacrificed. In dealing with loose bone chips extreme conservatism should be adhered to, and it is probably better to leave in some bone fragments that might die rather than adopt the policy of removing all loose fragments and thereby possibly discard many good supporting fragments that might live.

SUTURE OF SOFT TISSUE

As stated, the repair of jaw fractures cannot be totally separated from the repair of the soft parts and, therefore, a brief summary is included here.

a. *b.* *c.*

Fig. 3.—Representative patient with complete facial separation. *a*, Patient who had suffered multiple comminuted fractures of practically all the bones of the face shown three weeks after operation which was done under basal and deep block anesthesia one week after the accident. The *nose* was completely loose and shattered, and, as a result of swelling, was just on a level with the cheeks. An airway was established through both nostrils with a long speculum and maintained with rubber tubes, the palatal processes had cut through the palate in two places and these were forced back into place at the same time. The dorsum of the nose was elevated and held with a double sling of silver wire from side to side, put through the fracture lines along the frontal processes with large cutting needles and held on the side of the nose over lead plates as shown. The *inner canthi* were widely separated by an actual chiseling open of the face as the nose was driven backward. The canthi were replaced at the same time the nose was elevated and the fixation of the nose has helped to assure correct position and direction of the inner canthi. The *orbital borders, zygoma* and *antrum* are considered together because, as the zygoma is loosened, the border goes down and the antrum crumples under it. If the zygoma is driven backward, the zygomatic process of the temporal bone is crumpled either in or out. Restoration is done by making a small incision in the upper buccal fornix, entering the antrum through the fracture line and then replacing the orbital border, the frontal process, and the bulk of the zygoma and, if necessary, packing the parts in place by filling the antrum carefully with an iodoform gauze pack. The fragmented zygomatic process may be carried inward by external pressure, or lifted out with a small hook under it, placed either from the outside, through the mouth, or down from the temporal region as suggested by Gillies. The *upper alveolus* was broken in all the way on the left and was carried back into position and held with direct wires on the teeth across the fracture line and finally with fixation to the lower jaw. The *lower jaw* was broken through the symphysis and was held with the type of fixation shown in Fig. 5*b*; the upper jaws were used to support the lower and vice versa, although both were broken. *b* and *c*, Shows complete restoration of contour with normal expression, normal position of the inner canthi, no diplopia, normal vision, and normal occlusion. The most prominent feature of the profile, the dorsum of the nose, is restored. One operation.

In complicated tears such as shown in Fig. 1, a correct replacement may be difficult, but a start is made at some known point such as the nostril border, or the edge of the eyebrow. If none can be figured out, closure may be started in the center of a wound and the remaining segments bisected with sutures until there is complete closure. If flaps are torn loose in a trap-door or triangular

Fig. 4.—*a, b,* Simple type of splint for elevating dental arch and face. Made by Dr. J. A. Brown for use in patient shown in *c* and *d*. The tray is filled with dental compound before it is used, and is held with a simple elastic sling from the top of the head. *c,* Patient with blindness in the left eye, complete transverse and multiple facial fractures with almost total loss of the left upper jaw. *d,* Restoration of occlusion, nasal position, and of the cheek prominence with a free costal cartilage transplant. The right inner canthus is still somewhat displaced, as evidenced by the sharp curve of the tarsal border.

manner, their correct reapproximation is extremely important if involving a feature. In this patient (Fig. 1), the entire eyelid was closed in a position too far advanced on the forehead, and the lid had to be opened completely and re-sutured before the patient left the operating room.

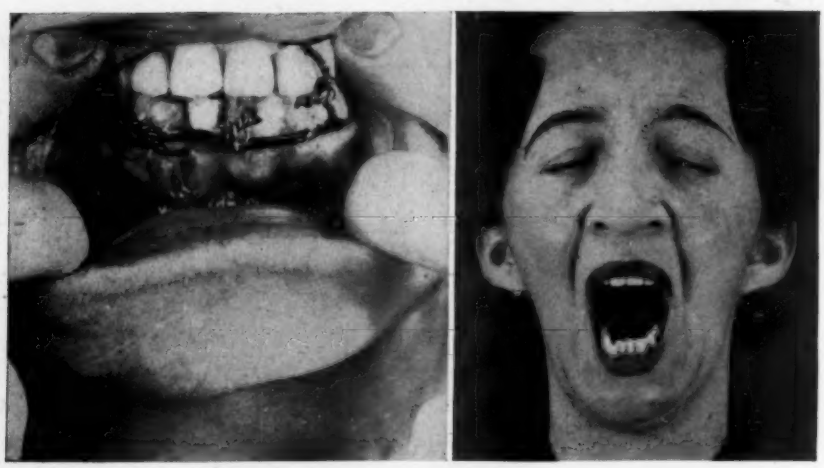
Close attention should be paid to the wound edges to see that they are in apposition, and, of course, very ragged edges should be cleanly excised. The first sutures may have to be deep but should never be placed far from the wound

edge because wide suture marks can never be completely obliterated. Many times widely placed sutures may be put in, however, but left open until the entire wound is closed; then they are tied over a gauze pad to bind the wound closely together and to avoid the surface cutting of the suture.

It is best to effect complete closure of the wound with deep, fine No. 000 white silk sutures so that, when the final skin sutures are inserted, they are merely to support the edges and adjust them. If possible, stay sutures may be put in from the inside of the cheek or nose.

Small drains may be placed advantageously, and firm, pressure dressings of mechanic's waste or marine sponges can be applied finally to control hemorrhage and swelling and, thereby, infection.

Fig. 5*a*.



b. *c*.

Fig. 5.—*a*, Permanent loss of occlusion in upper jaw fracture which might have been prevented by using the lower jaw for a splint by simply wiring the two jaws in occlusion. *b*, Method of Risdon in applying an anterior arch by putting long wires on the posterior teeth, bringing them around in front, fastening them together, and then anchoring individual teeth to this arch with finer wires. Besides this support, which is used mainly for symphysis fractures, fixation to the upper jaw with the teeth in normal occlusion is done and support applied from the chin to the vertex, if necessary. *c*, Functional result obtained in a patient with a fracture at the symphysis and through both condyles as well as a separation in the left upper jaw by using the fixation shown in *b*.

DISPLACEMENT OF THE BONES OF THE UPPER JAW

Transverse facial fractures occur usually from heavy blows dispersed over the face. There may be a level of separation at the frontozygomatic suture line and at the glabella on both sides; there may be one through the wall of the antrum that may extend all the way around and involve the pterygoid region; and frequently there is a complete separation entirely around just above the dental arch. The whole face may sag down and become noticeably elongated, and the dental arch may be completely loose to the patient's own sensation and on moving it with the examining fingers (Figs. 2, 3, 4, 5, 6).

Fig. 6.—*a*, Comminution of the facial and frontal bones with involvement of the frontal sinuses, displacement of the inner canthi, and flattening of the nose. *b*, Patient seen a few hours after the accident and restoration done immediately, that is, replacement of the comminuted fragments, rubber tube left in frontal sinus to drain into the nose, fragments of nose held up and inner canthi replaced by through-and-through silver wire sutures, placed through the fracture lines of the frontal processes and held over lateral lead plates on the outside of the nose. *c*, *d*, Restoration of the nasal bridge and normal direction and situation of the inner canthi (one operation).

Nasal, septal, and palate fractures frequently occur along with the above separation, and these small thin bones may be comminuted into multiple pieces. The nasal structure, including the cartilages, may be completely crumbled, and there may be one or more complete lacerations through the palate caused by the disrupted bone cutting through; the nasal passages may be completely occluded also (Figs. 3, 6, 10).

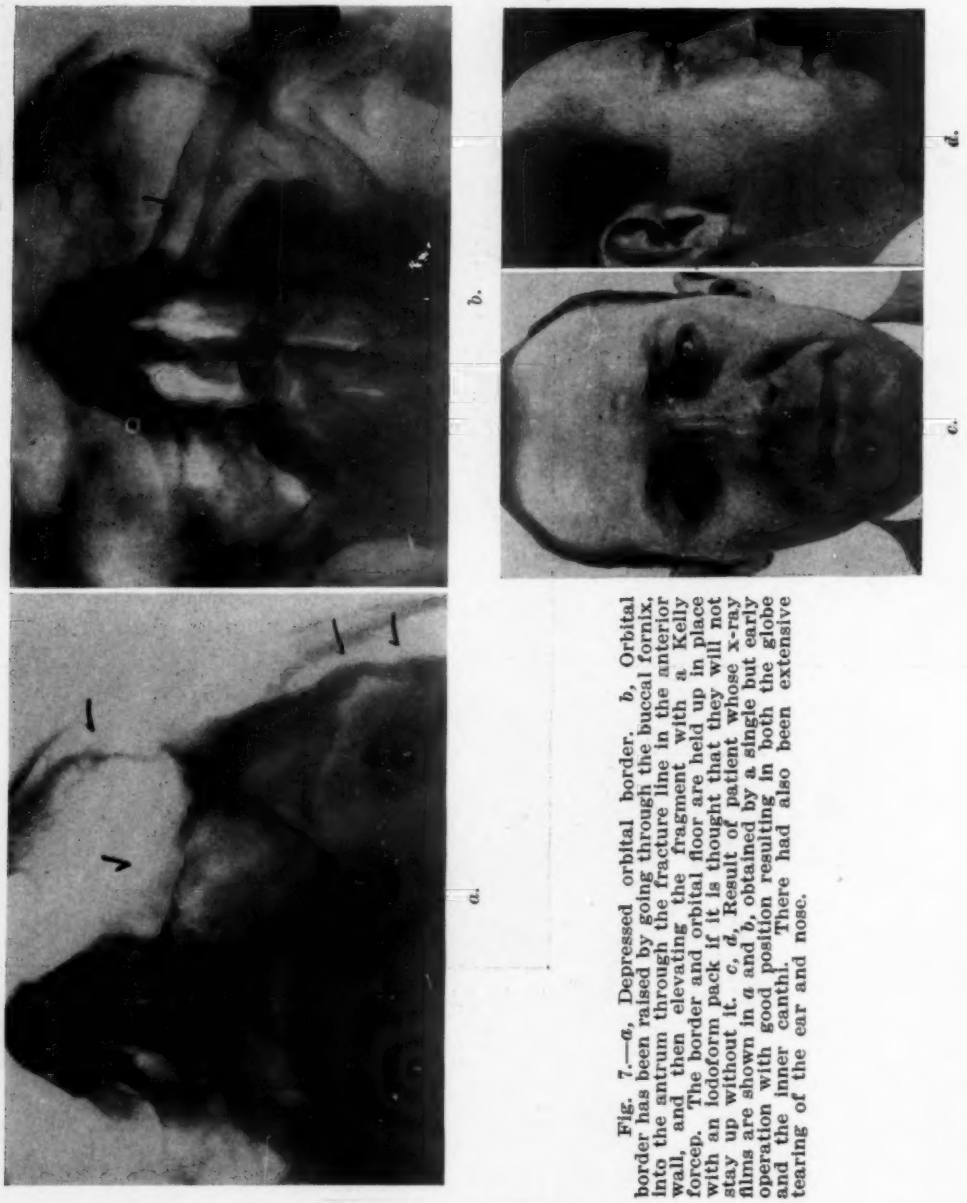
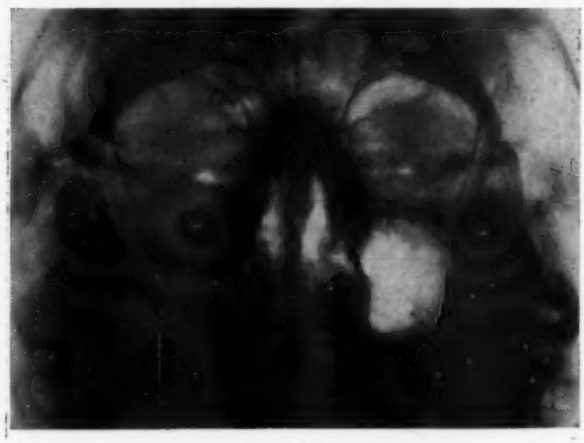


Fig. 7.—*a*, Depressed orbital border. *b*, Orbital border has been raised by going through the buccal fornix, into the antrum through the fracture line in the anterior wall, and then elevating the fragment with a Kelly forcep. The border and orbital floor are held up in place with an iodoform pack if it is thought that they will not stay up without it. *c*, *d*, Result of patient whose x-ray films are shown in *a* and *b*, obtained by a single but early operation with good position resulting in both the globe and the inner canthi. There had also been extensive tearing of the ear and nose.

The Zygomatic Bone and Orbit.—The zygomatic bone (malar or cheek bone) frequently receives the blow but is itself seldom broken. Instead, it is torn loose from its moorings at the frontal, zygomatic process of the temporal bone and the maxilla. The main displacement will be according to the direction of the force; if from the front, the zygomatic process will be crumpled back

and broken by the zygoma itself; if from the side, the ascending ramus of the zygoma may be tipped in and impinge on the orbital space. In nearly all loosening of this bone, the antral wall crumples, and, should it sag down too much, the orbit becomes elongated and the globe may descend so much that binocular vision is impaired (Figs. 3, 4, 7, 8, 9, 11). Blindness may result from section of the nerve by a loose, thin piece of bone and from intraocular or direct ocular damage. The extraocular muscles and nerves may also be torn (Fig. 4). The lacrymal apparatus may be impinged on if the frontal process of the maxilla is driven in.



a.

b.

Fig. 8.—*a*, Marked displacement of entire zygoma after two weeks with no hope of holding it in position from the inside of the antrum, because it is broken so far away laterally from any support. *b*, Zygoma replaced and held by direct wiring from ascending ramus to frontal bone; access to bone gained by opening a scar of accident. This elevation is usually not successful if fragment becomes firmly fixed out of position; then globe has to be elevated within orbit (see Fig. 9).

Inner canthus displacement occurs if the nose with the frontal processes of the maxilla is crushed backward, there being an actual chiseling open of the front of the face. This deformity is as important as any other in which to accomplish an early repair, because, if left until fixation occurs, the canthi probably never will be sunken in normally again (Figs. 3, 4, 6, 11).

Nasal flatness goes along with the canthus displacement and the two are corrected together by withdrawing the depressed tissues and bones, molding

them into their normal positions, and frequently holding them there with through-and-through silver wire sutures inserted under the separated frontal processes and held on the outside of the nose over lead plates (Figs. 3, 6, 10).

Fig. 9.—*a*, Loss of lateral wall and floor of orbit so that no elevation is possible. *b*, Patient whose x-ray film is shown in *a*. The main object of restoration is for eye function, as there is marked depression of the bony orbit, complete ptosis of the lid, and paralysis of the frontalis. *c*, Globe elevated with one block of free costal cartilage and held medially with another. With this replacement of the globe there was subjective improvement in the ease of ocular movements. Binocular vision does not always return after this procedure because of the delicate balance necessary for this function. Elevation of the lid was obtained by a fascial loop to the forehead and a second long one from the temporal fascia through the tarsus to the opposite frontalis. The upper orbital border was restored with a costal cartilage transplant put in a periosteal sling to give good fixation of the graft. All three pieces of cartilage were fresh homografts from the mother.

The general rule for repair is simply to replace these fragments and maintain them in position with the least manipulation possible. This replacement amounts to an open reduction, and access to the orbital border can be gained by a short incision in the buccal fornix, then into the antrum through the fracture line that is almost always present. The depressed border can then be elevated into position with a Kelly clamp. This bone may be locked in place, but, if there is much comminution, the whole number of fragments, including the anerior and lateral walls of the antrum, may be "mulched" in position and held with an iodoform pack in the antrum, with the end left just through the opening in the fornix.

If there is derangement of occlusion, the lower jaw can be used to splint the upper by fixation of the teeth followed by the application of a bandage

from the chin to the top of the head. Frequently, the closing power of the muscles attached to the lower jaw will suffice for this, and the overhead pull can be omitted (Figs. 4, 5).

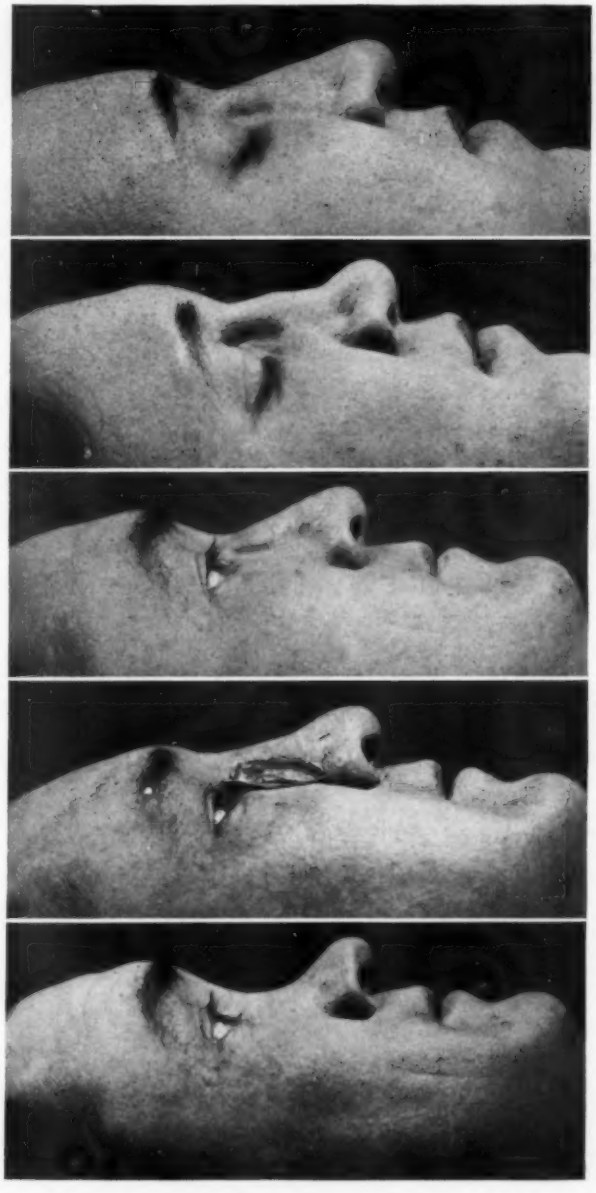


Fig. 10.—*a*, Complete depression of the nasal dorsum from injury without loss of tissue. *b*, *c*, Complete restoration of dorsum by chiseling free the depressed bone and cartilage and holding it forward on a mattress wire sling. *d*, *e*, Depression following injury plus loss of tissue so that free cartilage transplant is necessary for elevation as in *e*.

ILLUSTRATIONS OF GENERAL TYPES OF LESIONS

The most frequent lesions are described by the following representative patients, and the legends of illustrations may be followed as part of the text:

Restoration of Contour After Complete Facial Fractures Without Special Splints.—Diagrams and roentgenograms of typical complete facial separations are shown in Fig. 2, and a patient, completely restored after the most extensive facial fractures of this type, is shown in Fig. 3 with the operative procedures outlined in the legend.

Elevation of Sagged Upper Jaws With Dental Splint.—In Fig. 4 a simple type of apparatus for elevating upper jaws is shown, made by Dr. J. A. Brown, for use in the patient shown in Fig. 4, *c* and *d*. This does not insure normal occlusion, and, when it is removed, if there is any tipping of the upper alveolus,

Fig. 11.—*a*, Depression of frontal area, deformity of lid and inner canthus. *b*, Result of "packing" tissue down into lid from forehead in V-Y procedure through old scars. *c*, Result of fastening tarsal border to frontalis muscle for elevation of lid, and of filling the bony depression with free fascia.

the teeth should be forced into their normal occlusion and held there by interdental wiring to the lower jaw, and, if necessary, support should be applied from the chin to the head.

Blindness in Compound Facial Injury.—The patient in Fig. 4, *c* and *d*, illustrates the loss of vision frequently seen, and shows fairly normal replacement of the soft parts, re-establishment of occlusion and the building out of the depressed left cheek with costal cartilage.

Loss of occlusion in upper jaw fracture is shown in Fig. 5*a* where interdental fixation with the teeth in occlusion had been omitted.

Anterior dental arch plus jaw-to-jaw fixation is shown in Fig. 5*b*, the type used in the patient in Fig. 3 and also in the patient in Fig. 5*c*, who had a symphysis separation and fractures of both condyles. This illustrates the use of the lower jaw to splint the upper.

Fractures Through the Frontal and Ethmoid Sinuses; Inner Canthus Displacement.—Sinus involvement is shown in Fig. 6 with the fracture through the wall of the frontal, and with wide separation of the inner canthi and complete flattening of the nose, repaired so that practically normal position of the canthi and of the nasal dorsum results with a simple fixation as shown in Fig. 3*c*.

With involvement of the frontals and ethmoids there is some possibility of direct dural contamination, and the added precaution must be taken to maintain drainage into the nose without irrigation or manipulation that might carry infection up to the dura. If the sinuses are already infected, the chance of spread is greater.

Elevation of Orbital Border Through Buccal Fornix; Incision and Antral Fracture Line.—In Fig. 7 the inner part of the orbital ridge is down in *a* and is back in place in *b*, supported with an iodoform pack in the antrum. In *c* and *d* the normal profile and, from the front, the normal position of the globes and the inner canthi are shown.

Zygomatic Bone Versus Zygomatic Process Fractures.—Some confusion has arisen in relation to these two fractures both of which are illustrated in Fig. 7 *a* and *b*. The zygomatic arch is part of the temporal bone and is broken only occasionally by itself but is often crumpled in or out by fractures of the zygoma. The various maneuvers, recommended to lift out zygomatic process fractures, do not usually apply to true displacements of the zygoma itself.

Direct fixation of a completely loose zygoma is shown in Fig. 8 by drilling the frontal bone and the ascending ramus of the zygoma and anchoring them together. It was done in this instance because the very loose bone could not be supported from inside the antrum.

Consideration of Late Deformities.—If the late deformities are studied, the requirements of early care may be made more clear; and, since many secondary corrections have to be made, some responsible person or the patient himself should be told of this possibility in all severe injuries.

Elongation of the orbit because of depression and loss of zygoma is shown in Fig. 9. Restoration of eye level has been obtained by elevation of the globe with costal cartilage transplants along the floor and in the lateral region.

Late restoration of nasal bridge and profile, using the tissues that have been crumpled in, is shown in Fig. 10, *a*, *b*, and *c*. The depressed bone and cartilage dorsum was literally dug out of its enfolded position and then held forward on silver wire slings from side to side.

Late restoration of profile with costal cartilage transplant is shown in Fig. 10, *d* and *e*, where it has been recognized that tissue has been lost at the time of the accident or from infection. Elevation is effected with transplanted costal cartilage cut in one large piece to replace the entire loss of the septum and give support to the tip through the columella.

Filling in of skull defects, secondary soft tissue correction, and correction of traumatic ptosis, is shown in Fig. 11. The lid has been brought down so that closure can occur, by "backing" some of the forehead tissue down into the lid in the form of a V-Y operation and going only through the old scars. The depression of the forehead has been filled with a free fascia lata transplant. Cartilage may also be used for this. The residual ptosis has been corrected with a free fascial loop from the tarsus to the frontalis muscle.

THE MOUTH: THE IMPORTANT CENTER OF LIFE AND OF DEVELOPMENT OF THE HUMAN ORGANISM

Sucking, Weaning, and Mastication

Prof. Dr. C. D'Alise, Naples, Italy

THE imperfect estimate of the important function that the mouth is destined to fulfill in the life and development of the human organism after birth has been and is still, in my opinion, the fundamental cause of many deviations in the study of the knowledge of man and consequently of the continuous and progressive decadence of the human race, especially among civilized peoples, who, impressed by the progress reached by man himself in the various branches of knowledge, have thought of creating life from matter, denying God and creation. At birth two essential functions begin in the newborn child, respiration and nutrition. While respiration is an involuntary automatic function, nutrition is determined by the instinct that then with the psychic development becomes voluntary.

Therefore, at birth the mouth is ready in its organic development to accomplish its important function in the nutrition of the newborn child who, detached completely from the mother, still draws its aliment from her during the first year for his further development. If the maternal milk is the unique and complete aliment for the newborn child, the sucking at the breast is the inherent function.

The function of sucking, however, if it has as its principal aim the taking of milk from the maternal breast for nutrition, has also another purpose, another aim, the development of the mouth and the related organs. The latter function, closely bound to the former, has been little studied and still less valued, because we in every act, in every organic function, see and note only the principal finality and overlook the minor purposes, which are also necessary and which together with the principal constitute the harmonic complex function of every organ. Endocrinology, which, in this moment of the history of medicine, dominates the physiology of the human body, has justly demonstrated this truth; namely, that the endocrine glands have not a unique function and are closely interrelated.

In the sucking at the breast, we must look not only to the immediate end of the taking of the aliment, but also to the complex of the physical, chemical, and reflex acts accomplished in the infant for its life and its development.

It is useful therefore, as far as man's knowledge allows, to study with synthetic criterion the various functions that begin at birth and transform themselves little by little as one advances in age and development. And here clearly emerges all the importance of nipiology, of that science which occupies

Read before the European Orthodontic Society, London, 1938.

itself with the study of child life in its first year of existence, that is, the period of sucking; for, while in other mammalia all the functions that occur in this period are guided by instinct, in man, on the other hand, such functions occur by instinct in the baby but are guided and controlled by the will of the mother. In normal organicoconstitutional conditions of the mother and child, the sucking occurs with a regular reflex rhythm provoked by the exigencies of the life of the baby, who does not act of his own will, for at this age will does not exist, but by force of the instinct of self-preservation. This we call instinctive will, which then, little by little, is transformed into conscious will. In fact, after the respiratory movements, which are the first that the baby makes as soon as he is born, come the reflex movements of sucking, and then those of flexion and extension of the upper limbs which, according to some researchers, in the first days would be involuntary and then become voluntary after the third month (movements of manual prehension).

Among the many functions that establish themselves in the newborn child, sucking represents a function of notable importance, and is worthy of much greater attention than it has hitherto received.

Now leaving to nipiology the general study of the functions that begin and occur in the child in this period of its life, I shall discuss more especially first sucking and later mastication, which is the function analogous to sucking, in regard to the nutrition and the development of the face.

Dreyfus, some years ago after comparative studies between sucking at the breast and sucking at the ordinary nursing bottle, showed that sucking at the breast requires a far greater muscular intensity than that required by taking the usual bottle and that therefore artificial feeding, apart from the failure to require sufficient muscular intensity, is also a frequent cause of malocclusion. To correct this deficiency, Dreyfus has studied and put in practice a type of nipple that requires almost the same muscular effort and the same series of motions required by nursing at the breast, making a notable contribution to the etiology and to prophylaxis of malocclusion and of some nutritional diseases of the infant.

But if Dreyfus' contribution has been important, we must not stop with the primary muscular function but must see in it an ultimate function and study with intensive data the reasons why the infant sucks rhythmically, and what causes may alter the rhythm and fullness of the sucking.

We must first consider three fundamental elements of sucking: touch, taste, and movement. These contribute to the nutrition of the infant and are common also to other mammals, which as Claude Bernard observed, all suck before they become herbivorous, carnivorous, or omnivorous.

It is well, however, to study the mechanics of sucking. The majority of observers believe that the lips apply themselves hermetically on the nipple, the isthmus of fauces closes itself, and the mouth cavity works as a pump in which the tongue makes the void, bringing itself before and behind in the form of a piston. The atmospheric pressure exercising itself on the breast, the reservoir of liquid, forces the milk toward the point where the negative pressure exists—the mouth (F. Viault and F. Jolyet). Besides the lips that apply themselves to the nipple, there are the alveolar arches containing the crowns of the deciduous teeth covered by the gums, which in the region of the four canine teeth

form two membranous projections (studied and described by Magitot and Robin) and which during sucking have the effect of another pair of lips.

According to other authors, the mechanism of sucking is different. The tongue does not have the function of a piston, but encircles the nipple at its lower surface forming a gutter for the transit of the milk. The aspiration is through the lowering of the mandible.

However, I think that the mouth in sucking acts as an aspirating and pressing pump and that the transit of the milk from the breast into the mouth of the infant is aided, also, by the contraction of the myoepithelial fibers existing in the glandular acini and in the excretory ducti. Contraction results from the reflex action through stimulation of the sensory nerves of the nipple.

The number of sucking movements in a minute varies in different infants, but, according to Binet, the average is ninety, and the rhythm is more rapid at the beginning than at the end of nursing.

The capacity of these movements is not uniform; often they have a periodicity, and the weaker movements increase progressively and then diminish. The force of the sucking measured by means of a manometer corresponds to 3 or 4 mm. of mercury for a feeble suck, 5 or 9 mm. for a medium suck, and 9 or 10 mm. for a strong suck. At the same time we must consider that the number of sucks and their strength are significant, for they should answer the need in quantity and quality of milk that the infant must get from the breast for his nutritive balance and development. Therefore, a perfect nervous mechanism for sucking is present from birth. The centers of this mechanism are in the medulla and are excited by mouth-touching and taste stimulations and probably also by the stomach, as it is possible also in the anencephali.

At birth, the human being is above all vegetative; the functions of relation are rudimentary, and if taste and touch are developed, it is because the functions of digestion are highly differentiated and dominate the physiology of the newborn child.

From this it is logical to infer that, if the mother and child are healthy, sucking normal in rhythm and capacity occurs automatically by reflex action as in other mammals. It does not happen in this way, however, if the nutritive balance of the mother is not normal or if the child is constitutionally weak. In the first instance, even if the child is healthy, he cannot suck rhythmically and fully because the milk does not meet the nutritive needs of the infant. In the latter case, even if the mother is normal, the child, owing to his deficient constitution, cannot suck efficiently because the lowered calcium content of his body decreases the muscular tone.

This second condition occurs generally when the child takes the milk from a healthy wet nurse, because in practice the deficiency is present in both the mother and the child. (It is sad to note that these deficiency conditions become more frequent among the present generations of civilized peoples.)

In fact, among the disturbances that strike the civilized contemporary woman during pregnancy and nursing, those of the skeletal and dental system are more frequently manifested. From this the old saying, "For every child a tooth," is fully confirmed, while among children, first rickets, then dental

decay, and later malocclusion have become the rule, in spite of the undisputable progress of physiochemistry and of the chemistry of nutrition.

It is well to note that the first permanent molar, which erupts in the child's mouth toward the end of the sixth year, is the tooth which most frequently decays. The reason for this greater predisposition to decay is the structural deficiency of its crown, which calcifies in the period from birth to the end of the first year of extrauterine life. From this we may affirm that the greater frequency of the decay of the first permanent molar is a late revelation of the deficient nutritive condition of both the mother and child during the period of suckling.

This sign, to which I have often called the attention of physicians and dentists, has not been sufficiently valued and appreciated; yet I think it merits all the attention and consideration of those who occupy themselves with the study of the development of the human organism and, more especially, with its nutrition and life. Meanwhile from the summary examination that we have made of the mechanism of sucking and of the causes that may change the rhythm and the strength of the movements, we may note already the role of the mouth, which from birth appears to be an important center of biologic phenomena of the first order, which, as we shall see later, remains so for the whole of life.

In fact, the three principal factors in the function of sucking, touch, taste, and motion, which act in perfect coordination and interdependence in the mouth, suggest that from the birth of the new being, the mouth is not only a simple canal for the passage of food but also the initial point for digestion, and an important center for the skeletal development of the face and its related organs. This we shall see more clearly when speaking of mastication.

At birth all mammals suck the maternal milk, their only aliment, but the duration of the suckling and the manner of weaning, that is the transition from an exclusively liquid diet to a solid one, varies from mammal to mammal. In this respect man differs totally from others, since, while the young ones of all mammals, guided by instinct and by the organic development of each species, find in their surroundings the aliments necessary for life and their further development, the human infant, instead, not only depends much longer on milk for alimentation (one year on an average), but also even after this period needs to be guided by his parents for several years longer, otherwise he would perish.

Still we must recognize that man, in respect to other mammals, which in the zoologic scale are the animals nearest us as regards the vegetative life, is in an evidently less favorable condition. Thus we cannot admit that by the law of evolution he can come from any being but from man. If in the ontogenetic development vegetative life precedes the psychic, we must find the former perfected in man before the latter; so true is this that even today we find some primitive tribes which, guided by custom, far from so-called civilization and physicians, bring up their children well.

And, if then civilized man, in spite of all his supposed organic and psychic perfection, does not know himself and knows even less how to apply to his vegetative life the laws of nature which other mammals apply to perfection

by instinct, and if in regard to the knowledge of vegetative life primitive man is superior to civilized man, what is the value of so much human science if it is not *sapientia?*

True sapience comes from God, and, when man denies God and the creation, he applies his science badly. In fact, we have observed that at birth there is no difference between man and other mammals as regards suckling, but there is a difference with regard to weaning. For in other mammals instinct, which is the law of nature, acts; in man instead it is the reason of the mother, who should know how to interpret and apply the laws of nature in weaning the baby. Alas, however, human pride tries to elevate itself above nature and errs.

An excellent guide in the nutrition of the infant after suckling could be and really is the dental system. Fossilized teeth and mandibles (the mandible found at Mauer near Heidelberg), that have often been, and still are today, used to demonstrate the actual and progressive deterioration of the dental system, would indicate a logical consequence of the law of evolution and hence be an expression of progress. The deterioration of the teeth has shown instead only one thing: that with the deterioration of the teeth the whole organism declines, including reason.

That is, that in view of the evident fact of the progressive and continuous increase of dental decay and of the paradental and dentofacial deformities, the index of general deterioration of the entire organism, the atheist scientist does not know how to resign himself to defeat and with fantastic arguments tries to alter the truth; but the truth is and remains such in spite of all the sophisms of the man of science.

The dental physiopathology is still ignored by the great majority of physicians; therefore, they can never have an exact conception of man's life, or much less of his development, and dentists and orthodontists who do not know the physiopathology of the entire human organism nor how to value the interdependence with that of the other organs of the body believe that with the progress of man the teeth tend to diminish in number and size.

At birth the deciduous teeth still closed in the alveolar crypts of the jaws, are all formed and calcified and through the gingivae which enclose them aid in squeezing the nipple of the breast in order to press out the necessary milk. Between the seventh and eighth month, with the beginning of eruption of the deciduous teeth, a very important organic system comes into play in the life of the infant; the dentition is completed in about thirty months. During this time the infant, having twenty teeth, ten for each jaw, which allow him an alimentation similar to that of an adult, must still be guided by his parents for his nutrition and for his adjustment. This guidance presupposes a precise knowledge of the natural laws of life and of the development of man. I am not here to describe to you the chronology and the modality of the eruption of the deciduous teeth because they are known to you, but I shall stop to consider the finalities of these new organs.

The eruption of the mandibular central incisors, then of the maxillary central incisors, and afterwards of the mandibular lateral incisors which are fol-

lowed by the maxillary lateral incisors indicates the beginning of a new function, the masticatory function, which substitutes the sucking. As in the sucking, so in the mastication, the touching, tasting, and moving factors continue their action in the nutrition and in the facial development of the child.

In fact, the apparition of the first deciduous teeth indicates that the child must progress from exclusive milk alimentation to a mixed alimentation and then to a solid one. And so, if milk is the exclusive aliment of the first months, after the eruption of the incisors, it becomes the principal aliment. Later with the eruption of the molars it must be completely replaced by a solid alimentation. If not, what is the purpose of this wonderful organic system that nature puts into the mouth of man?

In harmony and in co-ordination with the dental system, the human organism from birth secretes all the diastases necessary for nutrition. The saliva has amylolytic power which progressively increases from the first days of birth till it reaches a double power at the end of the first year. The gastric juice contains the lab ferment, pepsin, and hydrochloric acid, and the ferments of the intestines are present also.

Besides the digestive function, the teeth serve in the harmonic development of the face and also of the skull. This second function, set in a new light by recent studies, has not been sufficiently valued even by the stomatologists and dentists, who have been the first to call the attention of the physiologists to this important function of the teeth. One need only observe the development of the deciduous teeth in order to comprehend their finalities.

In fact, the eruption of the two mandibular central incisors and of the maxillary central incisors lets us see not only their own function of cutting the foods, but also shows us that they establish the anteroposterior and the central relations between the mandible and the maxilla. The thickness of the woman's nipple establishes and maintains the height of the dental arch until the first deciduous molar has reached its normal height.

This fact, simple but important, has not yet been sufficiently valued by the orthodontists, while the failure of the function of the deciduous incisors which logically is followed by that of the permanent ones, represents a fundamental starting point for the pathogenetic study of the Class II malocclusion of Angle.

It is said that the infant instinctively makes the incisors function from their first appearance in the mouth; however, a misunderstood interpretation of the law of nature causes mothers and physicians to eliminate the foods adequate for such function. Therefore, we still see today that the primitive peoples, guided by experience and by usage, bring up their infants better than we.

At about thirty months the baby possesses twenty teeth, ten for each arch. These are indispensable for vigorous mastication not only for a normal digestion of food, as I have shown in a recent work,[1] but also for normal and harmonious development of the face.

It is now an accepted fact that in the present generations the face tends to diminish in volume, but by the greater part of the researchers this fact is held as an expression of progress. Thus in the progressive betterment of the human race the cerebral cranium, according to them, should be developed more, and should progress at the expense of the facial cranium.

I am not of this opinion, and think that the progressive increase of the dentofacial deformities, of which the diminution of face volume is the most evident expression, is an index of deterioration of all the organism.[2]

According to Emile Devaux,[3] the brain of the fetus has considerable volume: at two and one-half months it represents one-half of the body; at birth a tenth part; while it is the fiftieth part in an adult. According to anthropologic data, the relations between facial cranium and cerebral cranium are: 1 to 8 at birth; 1 to 6 at two years; 1 to 4 at five years; and 1 to 2 in an adult.

Why does this difference of development between the volume of the brain and that of the body, and between cerebral cranium and the facial exist? I premise that the old belief, affirmed and sustained by Cuvier, that a relation exists between the volume of the brain and the intelligence of the animal has no foundation; in man the weight of the brain is almost constant in the same race, 1.364 kg. in man, 1.236 kg. in woman. In man from birth to five years of age, the weight of the brain increases four times and at five years weighs almost as much as that of an adult. It is not, then, a question of quantitative development, but rather of the qualitative development of the nervous cells; for after the twentieth year, although the weight of the brain is stationary and may even diminish, the intelligence increases.

More interesting and more demonstrative for our study is the disharmony of development between facial cranium and cerebral cranium which in the present generations increases in proportions disastrous for the life and the future of civilized man. They are, among others, the very frequent asymmetries of the face, the gothic palate, and the mandibular infantilism that greatly disturb the two fundamental functions of the vegetative life of man, respiration and nutrition, and that at the same time, diminish the organic resistance and the defense against infective diseases such as tuberculosis. If for a greater psychic development of the brain, a greater increase of the cerebral mass is unnecessary, what is the use of a diminution of face volume?

"Mens sana in corpore sano" finds here the most evident demonstration and should therefore convince the evolutionists of their mistake and make them see that psychic progress is only possible with harmonic progress of all the parts of the body.

The study of the dental system, the jaws, and the physiopathology of this marvellous organic system should, and could, lead us to more complete knowledge of the human organism, on condition that we approach with open minds.

With the completion of the milk dentition in about thirty months, the body of the mandible is entirely occupied by ten teeth, and the distal surface of the crown of the two second molars is almost in contact with the anterior border of the ascending ramus. In this position we find the first, second, and third permanent molars, respectively, to the end of the sixth, twelfth, and twentieth year, however, without modification in form and length of that part of the body of the mandible occupied by the permanent incisors, canines, and premolars. This great osseous development of the angular region of the mandible, which corresponds to a similar development of the tuberosity of the maxilla, demonstrates to us the intense activity of the muscles of mastication. It also shows us that such activity has other purposes of which we still know little.

I will not stop to describe the various phases of development of the jaws, because that has been done by many students and especially well by John Hunter and Sim Wallace, but I shall try, instead, to inquire into the other functions of mastication. At birth the muscular system is little developed because until this moment the movements are minimum, and it is after birth that they enter into their full activity first by breathing, then by sucking immediately after, and then by the movements of the limbs. Parallel to the muscular system is the osseous system which after birth enters into its full development. If the activity of the trunk and limb muscles serves to develop these parts of the body, the mastication muscles serve to develop the head. If we resort to physical exercises when the working of the trunk and limb muscles, owing to our social occupation, is defective, we should do likewise for the mastication muscles, for this masticating activity is an essential condition for a normal nutrition, which is indispensable for every normal human activity, whether psychic, physical, or chemical.

We have seen that at birth the digestive functions dominate the physiology of the baby. Such domination does not diminish in adulthood, and the digestive function of the mouth plays the principal part in it. The proof of this is the anatomy and the physiology of the mouth. In fact the mandible, the active organ in the masticatory function, may be considered as a lever of the third degree in which the power is represented by the muscles of mastication (masseter, temporal, and pterygoid), the resistance by the food, and the fulcrum by the temporomaxillary joint. From this one sees that in mastication the muscular force of contraction increases progressively from the front of the mouth to the mandibular angle; consequently, the masticatory power of the third molar is greater than that of the second and first molars.

To this we must add the function of the tongue, which, while it is primarily muscular, is sensory in that it functions in touching and tasting. The gustatory papillae are placed at the margins and the tip in order that they may be in more direct contact with foods during chewing. Besides vigorous and prolonged mastication stimulates an active blood circulation of the head necessary for the metabolism of its organs and serves also to keep in useful equilibrium the bacterial flora, aiding and increasing the local immunity of the month.

With prolonged mastication we determine automatically the quantity of the food necessary for the nutritive balance of the human organism as Fletcher, Chittenden, Fisher, and Mendel have scientifically and practically demonstrated; and as it constitutes also an important element of thermoregulation of the alimentary bolus for a better digestion in the stomach, we may affirm that mastication is a function of first importance.

In closing this analysis of the physiology of the mouth I repeat that the two dentitions, deciduous and permanent teeth, are a sure guide in the choice of aliments. In fact, we note that in the first dentition premolars do not exist, but true molars, owing to their shape and the number of their roots, do not differ from the permanent molars, as these have an exclusive function of grinding in mastication. This means that the child must be furnished with adequate and appropriate aliments. This is confirmed also by the eruption at six years of the

first permanent molars, which together with the two deciduous molars, constitute a series of three molars for each side and each jaw.

Now this evidence from nature on one hand and the erroneous choice and preparation of aliments among civilized peoples with all the harmful consequences on the other clearly prove that the study of human alimentation must be guided by the law of nature made by God and not by laboratory rules made by man.

SUMMARY

Sucking and mastication are analogous functions of maximum importance in the nutrition and in the development of the human organism and comprise the following: first, the function of taking and transforming aliments; second, direct digestion, that accomplished in the mouth, and indirect digestion, the reflex preparation of food for the remainder of the digestive tract; third, the gustatory and touch functions for the foods on the part of the tongue; fourth, the thermoregulation of the aliments; fifth, the autoregulation of the necessary quantity of food; sixth, the development of the organs contained in the head; seventh, the defense against the pathogenic microorganisms proper to the mouth and against those that eventually may penetrate there; and eighth, the guidance of the choice of foods.

REFERENCES

1. D'Alise, C.: Bread in the Development of the Human Face and the Prophylaxis of Malocclusion, Dental Record, 1937.
2. D'Alise, C.: La razza umana è in decadenza, Riv. Ital. di Stomatol. February, 1937.
3. Devaux, Emile: Les causes physiologiques de la prééminence du cerveau chez l'homme, Rev. scient. Aug. 23, 1924.

SOME OBSERVATIONS ON THE LABIAL ARCH

L. M. Christie, D.D.S., Washington, D. C.

NO ONE knows when the first mechanical device was used to influence tooth movement, but it seems probable that one of the oldest principles known in orthodontic therapy is embodied in the labial arch. Anyone investigating the origin of the labial arch might well be reminded of the words of Solomon, "And there is no new thing under the sun. Is there a thing whereof it may be said, this is new? It hath been long ago in the ages which were before us."

Over two hundred years ago Fauchard, the father of dentistry, described what he called the "bandelette" as a piece of metal extending around the dental arch with holes drilled near its extremities to attach it to the teeth. This bandelette, which did not originate with Fauchard but which had been in use for an indefinite period before his time, was no doubt crude and insecure. However, its principle was essentially the same as that of the labial arch of the present day.

The first improvement in the attachment of the bandelette to the teeth was recorded in 1757 by Bourdet who advocated drilling twenty or more holes in the metal through which ligatures might be tied. These holes, he stated, should be exactly opposite the teeth "which are to be placed in order, so that the thread caught in the two holes which serve for each tooth may draw it toward the strip."

In 1803 Joseph Fox in his book, "The Natural History of the Human Teeth," described his use of the band as follows: "To remove such irregularities two objects must be accomplished; first, to apply a force which shall act constantly on the irregular tooth and bring it forward; second, to remove the obstruction which the under teeth, by coming before the upper, occasion.

"The first may be obtained by the application of an instrument adapted to the arch, which being attached to strong teeth on each side, will furnish a fixed point in front, to which a ligature may be applied and thus, by occasionally renewing it, a constant pressure is preserved and the tooth drawn forward. The second may be obtained by placing some intervening substance between the teeth of the upper and lower jaws, so as to prevent them from completely closing.

"This instrument may be made of gold or silver, strong enough not to bend easily. It must be bent to the form of the mouth, and it should be long enough to reach the molars. Holes are to be drilled in where ligatures are required, which will be on the parts opposite to the teeth designed to be the fixed points, and also on the parts opposite the irregular teeth. Then to the bar a small square piece of ivory is to be connected by means of a little piece of gold, which may be fastened to the ivory, and to the bar by rivets. This piece of ivory

Read before the Washington-Baltimore Society of Orthodontists, Washington, D. C., March 23, 1939.

passes under the grinding surfaces of the upper teeth, and being kept fixed there, prevents the teeth from closing and removes the obstruction." This was probably the first description of a method of removing interference.

Delabarre in 1815 described the use of a metallic box or crown in combination with a lever for rotating teeth, and Thomas Bell in 1829 used gold caps on molars to open the bite instead of the more cumbersome block of ivory previously used by Fox. It remained for Chapin A. Harris in 1839 and Desirabode in 1843 to record the first application of the cap or band on the molars for the purpose of a more secure attachment of the labial appliance. Desirabode describes the appliance as follows: "Then, upon the posterior and anterior faces of the teeth, we adapt a bandelette of gold, somewhat less wide than the height of the teeth, but touching them all in the direction of the alveolar border, terminated at each of its extremities by a kind of bracelet, or better still by a true cap, which envelopes the last two molars, upon which we wish to take a firm support. Before applying this little apparatus, we pierce each bandelette with two holes in the same horizontal direction, and precisely at the point corresponding to the irregular or oblique tooth. Finally, when it is applied, we pass through the holes a thread of raw silk waxed, or a platina, and twist them around the tooth to be replaced.

"This apparatus, which is the only one we employ, as it is much more sure than the simple thread, has this advantage, that its action is constant. This continuousness results from the incessant action of the spring reacting upon the thread. The power may be increased by arranging the spring that it shall not touch the teeth which form the side of the vacant space to be refilled by the tooth to be retained. We have cited the simplest case in which the band is applied; but it is easy to perceive that it might be used upon several teeth as easily as upon one. It is only necessary, in complicated cases, to pierce the bandeau with as many holes, and pass through as many ligatures as there are irregular teeth."

Schange in 1841 described the first clamp band fixed by a screw device. In 1854 Evans recorded what was probably the first use of a metal tube soldered to the side of a plain molar band, through which was passed a hard-drawn flat wire to be lengthened or shortened by screw nuts. This appliance was quite similar to the labial arch as used today.

The greatest advance made in securing the stability of the arch was made about 1871 by the introduction of the cemented band, known as the Magill band. Guilford later described its construction as follows: "From a piece of platinum, German silver, or platinized silver-plate, number 28, Brown and Sharpe gauge, he cut a strip about a line in width and bending it to conform to the shape of the tooth, soldered it at the point where the ends overlapped, thus converting it into a band or ferrule. After attaching to this band any studs, pins, or hooks the case demanded, it was lined with oxychloride of zinc and slipped over the dried tooth to a point almost midway between the cutting edge and the neck."

It was at about this time (1871) that oxyphosphate of zinc cement was introduced into this country, so that by 1875, at the latest, everything essential to the construction of the labial arch as it is used today had been developed: the fitted bands, the soldered attachments, a good cement, the arch itself, and the

threaded ends and nuts for shortening and lengthening the arch. One might wonder why it did not at once come into general use, but it should be remembered that orthodontics at that time was in a chaotic condition. No accepted classification of malocclusion had yet been developed, and methods of treatment generally were empirical. Furthermore, the vulcanization of rubber had come into general use, and the dentist of the day naturally turned to the rubber plate, to which he attached wires and clasps, or sometimes used it in combination with wedges and rubber bands. The Coffin split-plate had been introduced about 1871. It consisted of a rubber plate divided in the median line and held in place by a piece of piano wire bent into a W shape. Jack-screws and traction screws were in general use. However, in 1882 Doctor Patrick announced his method of regulating, consisting of clamp bands for the molars, a half-round platinized wire, and various attachments for individual tooth movement. Kirk was using the labial arch in combination with vulcanite plates, and many others were utilizing the principle of the labial arch for individual tooth movement. It was not until the time of Angle that some order began to replace the chaotic condition that had existed in orthodontic diagnosis and treatment, and the labial arch came into general use.

At the Ninth International Medical Congress held in Washington, D. C., in 1887 Angle read a paper describing his method of treatment. In the following years he introduced his classification, the friction sleeve nut, the pin and tube appliance (1911), the ribbon arch and bracket bands (1916), and in 1928 the edgewise arch and brackets.

The round labial arch, generally 0.036 to 0.040 inch in diameter, has been in general use since about 1900. At first it was attached directly to the teeth by means of ligatures of various kinds, although it was sometimes attached to lugs or spurs soldered to bands which were cemented to teeth requiring rotations. Through the years many other attachments, one of the best of which is the McCoy open tube, have been developed. The force developed in this type of appliance would be classed as intermittent, since it depends upon the nut and threaded ends of the arch wire, plus the slight spring of the arch itself.

The tendency in late years has been toward the use of appliances producing a gentle, positive, and more nearly constant force. This has resulted in a greater use of light resilient wires, either alone or in combination with the heavier arch wires. This tendency toward the greater use of the smaller gauge wires no doubt has been influenced by the improvements in metallurgical processes, by the observation of the efficiency of the light auxiliary springs as used with the Mershon lingual arch, and finally by the introduction of the more resilient stainless steel wires.

One of the first uses of the smaller gauge wires in connection with the labial arch was the substitution of the loop of spring wire for the threaded end and nut, producing a more gentle and more nearly constant force.

In 1915 Robinson advocated the use of the light gauge wire as a labial appliance and described a method of constructing the arch of 0.022 wire, attaching it to the teeth by means of an interlocking seat and block. In 1917 Suggett suggested the use of the light gauge wires with the pin and tube.

The efficiency of the small gauge wires in stimulating tooth movement was recognized quite early by Doctor Hawley and others using the Angle ribbon arch and was employed for the purpose of aligning the teeth before adjusting the ribbon arch itself. It is now widely used in a similar manner in connection with the edgewise arch technique.

The high labial arch, as developed by Lourie, employs the light wire as the active force. The coiled spring, as advocated by Arnold, embodies the same principle. The arch used with the Griffin attachment is of a small gauge precious metal. In 1931 Andrew Jackson described his method of using the smaller auxiliary wires in combination with the heavier labial arch and special bracket hooks. In 1932 Ernest N. Bach suggested the use of 0.022 wire in combination with the high labial arch and the Angle bracket. In 1932 Johnson introduced his twin wire appliance. In 1937 Spencer Atkinson described his method of treatment, employing small gauge wires.

It would appear, then, that there is at present a quite general appreciation of the efficiency of the light resilient wires to produce a gentle, continuous stimulation of tooth movement. Probably the chief objection many have to their use depends upon the necessity of banding so many teeth. However, any labial appliance necessarily is conspicuous to a greater or less degree, depending upon the number of bands used in the technique adopted. Even in the use of the high labial arch, which is the least conspicuous of any of the modifications of the labial arch, bands are often necessary for the treatment of rotations, or for the efficient stimulation of root movement. Furthermore, in the use of any form of labial appliance it is often desirable to band some of the anterior teeth in order to stabilize the arch, if for no other reason.

When the smaller gauge arch wires were first used as a preliminary treatment before adapting the ribbon arch, it was discovered that the buccal segments had a tendency to spring outwardly toward the cheeks. For that reason, sections of ribbon arch wire were used for the buccal segments, the anterior segment of small round wire being soldered to them.

In the treatment of some types of malocclusion, in a somewhat similar manner, I have been using a light gauge wire of stainless steel, generally in combination with the lingual arch. The buccal portions are reinforced by lengths of steel tubing to which stops or spring loops and intermaxillary hooks have been soldered. This tubing has an inside diameter of 0.022 and an outside diameter of 0.038 and is fastened to the light arch wire, which passes through to the distal ends of the tubes, by pinching in two or three places with wire cutting pliers. Instead of soldering any attachments to the tubes, I sometimes bend the arch wire at the proper points into complete circles to serve as intermaxillary hooks, fasten on the tubes, and employ tightly wound spiral springs as stops, adjusting when necessary.

In the treatment of malocclusion, while it is generally agreed that there is no universal appliance, it may be said that the labial arch, or as Angle called it, the expansion arch, in one of its many forms is no doubt more generally used than any other type of appliance. In 1899 Angle said of it, "The expansion arch possesses qualities which will probably always keep it easily in the lead of

all other regulating appliances. By its use we have control over the entire dental arch, over the teeth individually as well as collectively, in contradistinction to the vast number of appliances which have been devised to act locally.''

For many years the development of orthodontia, like that of dentistry in general, was mainly along technical lines, and as a result of this development we now have many efficient appliances to stimulate tissue change and influence tooth movement. The labial arch with its varied forms and modifications and the lingual arch with its auxiliary springs, together with the necessary bands carrying attachments for stability and force control, give us a wide selection of the instruments necessary for successful treatment. If we fail, the fault does not lie in the instruments at our disposal, but rather in our lack of knowledge of diagnosis, growth processes, and general biologic influences.

While it is no doubt true that orthodontic thought in the past has been mainly along mechanical lines, more recently the work of such men as Hellman, Lewis, Todd, Broadbent, Rogers, Howard, and others leads us to believe that orthodontic thought is now turning more to the biologic sciences. When we shall have acquired a greater knowledge of cell metabolism, nutrition, growth and function, we shall then know better when and how much to use the appliance therapy which is already so well developed, and which will no doubt always be necessary for the efficient treatment of dental deformities.

REFERENCES

Fauchard, Pierre: Le Chirurgien Dentiste, 1728.
Fox, Joseph: The Natural History of the Human Teeth, 1803.
Weinberger, Bernhard Wolf: Orthodontics, An Historical Review of Its Origin and Evolution, St. Louis, 1926, The C. V. Mosby Co.
Griffin, Edward M.: The Technique of Resilient Arch Assemblage, Internat. J. Oral Surg. and Radiog. March, 1931.
Bach, Ernest M.: Some Newer Designs in Labial and Lingual Appliances and Their Construction, Internat. J. Oral Surg. and Radiog., January, 1932.
Jackson, Andrew Francis: The Nature and Place of Mechanical Interference in Orthodontic Treatment, Dental Cosmos, 1931.
Johnson, Joseph E.: A New Orthodontic Mechanism: The Twin Wire Automatic Appliance, J. A. D. A., 1932.
Atkinson, Spencer R.: The Strategy of Orthodontic Treatment, J. A. D. A., 1937.

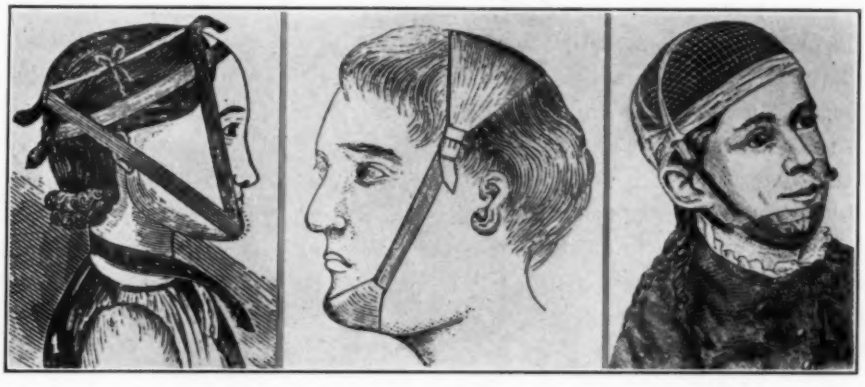
1835 Eye Street, N. W.

TAILOR-MADE CHIN RETRACTOR

W. E. Stoft, D.D.S., Omaha, Neb.

REVIEWING briefly the orthodontic literature of devices for retracting protruding mandibles, many of our pioneers, we note, seemed to find extra-oral anchorage indicated in cases where the retraction of the mandible was desired. Dr. A. Wescott in 1844 devised a chin cap to retrude the mandible. It seemed he advocated the wearing of this device continuously, removing it only to wash the face and teeth and to "rub jaw joints with some mild liniment." He also used bite blocks to form incline planes, changing the pitch of these blocks from time to time to increase the incline (Fig. 1.—*Orthodontics, An Historical Review of Its Origin and Evolution,* Weinberger, page 308).

Dr. Henry Sewill in 1869 advocated "an instrument fixed externally to treat cases by a constant upward traction of the chin, a cap of leather adapted to that part being attached to a strap across the head by strong elastic bands at each side" (Fig. 2).



Figs. 1-3.

In November, 1878 (*Orthodontics, An Historical Review of Its Origin and Evolution,* Weinberger, page 590), Dr. George S. Allan presented a paper entitled "Protrusion of Lower Jaw Treatment." In it he stated, "In April last, a little girl was brought to me for dental treatment only, but noticing that the lower jaw presented a very marked protrusion, I advised that it should be immediately treated with a view to the removal of what was a positive deformity, and was asked to undertake the treatment. The deformity was entirely in the under jaw, which was, as usual in such cases, of abnormal width, and projected so that the lower arch extended outside the upper throughout its whole circuit. Usually, in such cases, I direct delay, before beginning to operate until permanent teeth are all in place. But, after consideration, I adopted for this case a different plan. As the irregularity appertained to the jaw itself and not to the arrangement of the teeth, I decided to operate upon the jaw alone, and to bring about a correct articulation of the teeth as a sequence. I set to work to make

an apparatus that would pull the lower jaw back. As you will see from the photograph taken at the time she was wearing this apparatus, it consists of two parts (Fig. 3). For the lower part I made a brass plate to fit the chin, having arms with hooked ends reaching to a point just below the point of the chin. These arms were arranged in such a way that the distance between them could be altered at will by simply pressing them apart or together. The upper part consists of a simple network going over the head and having two hooks on each side, one hook being above, and the other below the ear. When this apparatus was completed and in use, there were four ligatures of ordinary elastic rubber, pulling in such a way as to force the lower jaw almost directly backward. I relied upon the elastics attached to lower arms to do the main work. The upper elastics were simply used to keep the mouth closed so that the lower elastics would not pull it open, the upper elastics being made just strong enough so that the child, in the natural operations of eating and talking, would not have to strain the muscles of the mouth to keep the jaw open. The work proceeded very rapidly, much more so than I had expected, so that at the end of two months, instead of six (as I had told the mother of the child it would take), the irregularity was almost entirely cured.

"I was puzzled at first to understand how I had obtained so great an amount of recession in the lower jaw, but on carefully examining the skull and position of parts at the child's age, the proper solution of the problem soon presented itself. The only way in which the change can be made is by pushing back the condyles of the jaw into the glenoid cavity. At five—the articulation between the glenoid cavity and the condyle is peculiar in that there is a double synovial membrane between which there is a cartilaginous bursa. This cartilage gives way and absorption takes place at the posterior side of the condyles, with filling in of the anterior so that the whole operation consists in pushing the condyles of the lower jaw into the glenoid cavity of the temporal bone. Until the articulation has again receded by the natural protrusion of the teeth I suppose the child will have to wear the apparatus more or less.

"I should certainly in any similar cases presented hereafter, even at twelve or thirteen years of age, before attempting any other procedure, try this first and thoroughly."

I have quoted rather fully from Dr. Allan's report of a case because it struck me as coinciding somewhat with my viewpoint on this subject. Other men, especially the late Dr. E. H. Angle, devised a chin retractor, but to my mind this was lacking in one or more desired features (Fig. 4). In the Dewey-Anderson book, page 435, is illustrated a homemade chin retractor (Fig. 5). Since patients object to wearing these retractors in public, the logical time to wear them would be while sleeping at night. Comfort in sleep is particularly desirable if not essential to success, since mental disturbances interfere with any desired tissue changes. That this has been recognized by orthodontists is shown by their efforts to simplify all appliances. Possibly the lack of a reasonably comfortable chin retractor accounts in part for the indifference orthodontists seem to feel toward these chin-retracting devices. Then too, there is the skepticism of many operators that such procedure is not likely to succeed.

What happens, if anything, when occipital or extraoral anchorage is used to retract the mandible? The idea that in these cases of mandibular protrusion the temporomandibular articulation is in a state of luxation may be logical and true in some cases at least. Another idea that the angle of the mandible has straightened out, becoming more obtuse, also sounds logical and may be true in some cases. Whether these ideas are both true in the same cases, variously affected, or whether other conditions present themselves will depend on the diagnosis of the case under consideration. Among these other conditions

Fig. 4.

Fig. 5.

may be undeveloped maxillary alveolar process, overdeveloped mandible, overdeveloped mandibular alveolar process, forward thrust of mandible due to enlarged tonsils, or habitual protrusion of mandible for various reasons.

Each case must naturally be diagnosed carefully, but the therapeutic measures need not be confined to the oral cavity when the forward malposition

of the mandible is the principal anomaly. To use the teeth as the means to correct mesioclusion when the mandibular dental arch is as irregular as the maxillary dental arch, or more so, is scarcely likely to succeed.

However, the purpose of this clinic report is to suggest an auxiliary therapeutic measure in mesioclusion cases. Having tried the Angle chin retractor I am sure that the patients were considerably disturbed by the wire rim of the headpiece. I also found that the metal chinpiece with its clothes-catching buttons was anything but comfortable. After trying all chin retractors that appeared practical and experimenting with different ideas, I finally worked out what I believe to be the most practical to date. In our first efforts my assistant

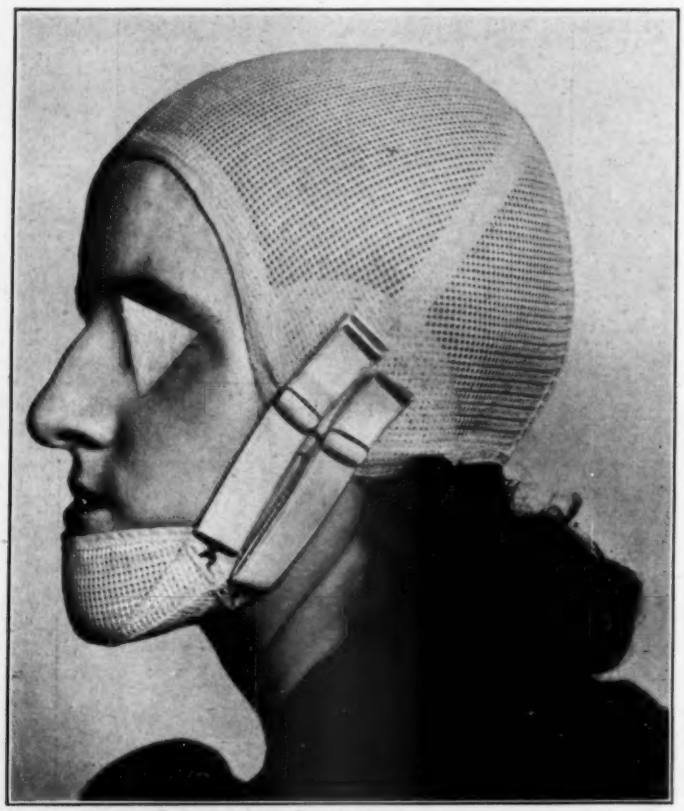


Fig. 6.

bought corsets made of porous but very strong cloth, ripped them apart, and used the cloth to fashion our first headpiece. I molded a sheet of wax over the chin and reproduced it in vulcanite, leaving holes in the ends for inserting rings. Rubber bands from hooks on headpiece to chinpiece produced the tension. Now we make the chinpiece out of the same cloth over a plaster model of a modelling compound impression of the chin. The cloth we now buy in bolts, because our friends sometimes ask for chin retractors. We attach two eyelets on each end of the chinpiece at an angle to insure proper retraction. Slip buckles are attached to the headpiece one above and another below the ear, above the part which laps over the ear. A doubled silk elastic length is slipped into slip buckles, but first this elastic is slipped into the slot of a hook and the hook is placed on the

closed end of the elastic to engage the eyelets of the chinpiece. Of course there are four hooks to correspond to the four eyelets on the chinpiece (Fig. 6).

I often employ this retractor as a test to determine the responsiveness or stubbornness of the patient. By telling them that I am merely trying them out, I often get a more favorable response than if I proceeded as if I were forcing them to the impossible. The successes I have had with this appliance have really made me feel so confident of results that I wish that more orthodontists would avail themselves of this aid in the treatment of mandibular protrusion cases.

Fig. 7.

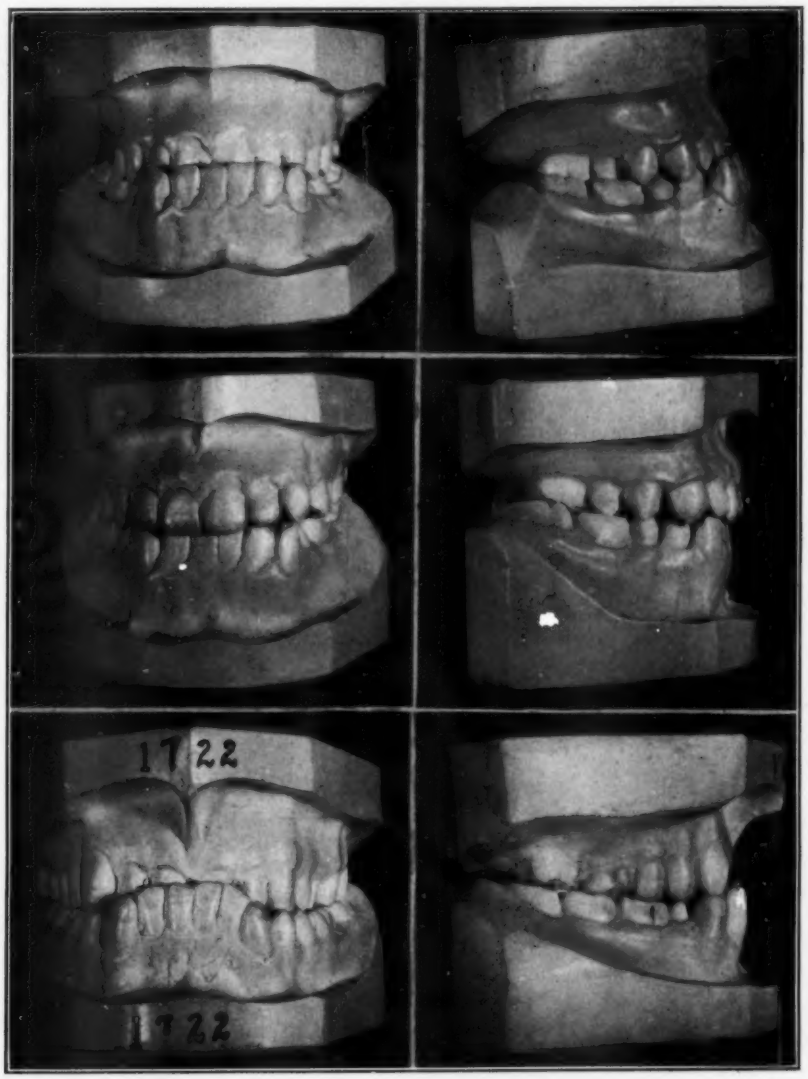


Fig. 8.

Fig. 9.

Fig. 10.

Fig. 11.

Fig. 12.

Figs. 7-12.

I have no scientific explanation of what happens when this appliance retracts the mandible. I do know it really does so sooner or later. I will mention two cases as probably the most surprising even to me. A boy, aged 16 years, was fitted with the chin retractor and sent home out in the western part of the state on Nov. 6, 1937 (Figs. 7 and 8). He returned on November 26, twenty days

later, with his mandible retracted from a relationship of a decided adverse overlapping of incisors to the desired relationship of mandibular incisors inside maxillary incisors (Figs. 9 and 10). This he was unable to do on November 6, though I tried hard to get him to do so. He could scarcely get them edge to edge with effort. He reported no real pain; only a peculiar feeling one morning when he found upon awakening he could place his mandibular incisors back of his maxillary ones. He says he tried to keep them in this relationship but could not the first day or two, but then he persisted and very soon was able to maintain this new relationship. His case was very unusual I admit, but I have had very few real failures.

In another case a woman about 35 years of age jumped the bite in six weeks. She reported severe pain in the glenoid fossa region and was reprimanded for increasing the pressure too much. This pain occurred early in the treatment, and when the pressure was eased off, the pain subsided. Other cases have been much slower in their response, but nearly all cases did respond in time if the patients cooperated. Naturally, good judgment should be exercised in the application of this device, and the suggestion is offered that no positive promise be made. Furthermore, I suggest again that the patient be put on probation at first to determine the degree of cooperation he is likely to give.

Hereditary cases nearly always respond more slowly than do cases with no such family history.

Figs. 11 and 12 illustrate a case where the chin retractor was not used since the maxillary incisors were in lingual version, and, when they were moved labially over mandibular incisors, the relationship of arches corrected itself naturally. This illustrates that diagnosis for each case is essential and that a chin retractor is not indicated in all cases where incisors are malrelated.

While I realize the chin retractor is not used to any extent by orthodontists, I have had so much satisfaction employing it myself since we evolved a comparatively comfortable tailor-made one that I am suggesting its use in cases of mandibular protrusion.

521-24 City National Bank Building

Department of Oral Surgery and Pathology

Edited by

STERLING V. MEAD AND KURT H. THOMA

Articles on oral surgery, radiography, and anesthesia should be submitted to Dr. Sterling V. Mead, 1149 Sixteenth Street Northwest, Washington, D. C. Articles on oral pathology should be submitted to Dr. Kurt H. Thoma, 53 Bay State Road, Boston, Mass.

EXPERIMENTAL WORK ON A METHOD FOR THE REPLACEMENT OF MISSING TEETH BY DIRECT IMPLANTATION OF A METAL SUPPORT INTO THE ALVEOLUS*

PRELIMINARY REPORT

ALVIN EDWARD STROCK, D.M.D.,† NEWTON CENTER, MASS.

THE replacement of a lost single anterior tooth in adult life constitutes a major problem for the dentist. According to the present technique, this can be accomplished in one of two ways. Either a removable or a fixed appliance can be made. The former has the disadvantage of being removable, and the latter often involves extensive sacrifice of sound tooth structure of teeth adjoining the space in order to attach the dummy to them.

For many years another method for restoring the space has been tried. This consists of implanting a support for a dummy tooth directly into the bone underlying the space. Various materials have been tried in the past, including vulcanized rubber, porcelain, and many metals. Maggiolo of Paris in 1809, Rogers of Paris in 1845, Harris of California in 1887, Edmunds of New York in 1889, Bonwill of New York in 1895, Payne in 1898, Scholl in 1905 (cited by Kirk[1]), and Greenfield[2] in 1913 propounded various modifications of the same idea. These failed for two probable reasons: (1) The material used by some, such as lead by Harris and Edmunds and iron by Maggiolo, was deleterious and set up activity resulting in erosion of the metal and resorption of the surrounding bone. (2) When a less active metal was used, as iridioplatinum by Greenfield,[2] the mechanics involved probably accounts for the lack of success. Greenfield's technique[2] consisted of trephining a hole in the bone into which was inserted a so-called "cage" which was to carry the crown. The cage was an iridioplatinum meshwork through which it was hoped bone would be laid down, thus holding the cage firm. The success of this was further impaired by placing one of these cages in the molar area and another in the canine area and suspending a bridge of gold from one cage to the other,[2] throwing a load on the implants which sound teeth often cannot carry.

It has been known for many years[3-6] that certain metals are better tolerated in bone than others. The recent investigations of Venable, Stuck, and

*From the Surgical Laboratory of the Harvard Medical School and the Dental Service of the Peter Bent Brigham Hospital.

†Former Dental Interne at the Peter Bent Brigham Hospital.

Beach[6, 7] on the reaction of bone to metal implants suggest that a substance known as vitallium, which consists of cobalt, chromium, and molybdenum, is completely inert when implanted in bone. By the use of this metal and by the use of the screw principle for fixation, as well as the restriction of the restoration to individual spaces, an attempt has been made to overcome some of these possible reasons for failure.

Fig. 1 *A* to *F*.

Fig. 1*G*.

The investigation has consisted of implanting vitallium screws in human beings and in dogs. Observations on human cases are as follows:

Case 1.—A. D., aged 31 years, came to the hospital on Jan. 15, 1938, to be treated for a fractured mandible. X-ray examination revealed a definite area of rarefaction about the apex of the mandibular right central incisor (Fig. 1*A*). This tooth was extracted at the time the jaw was wired on Jan. 15, 1938. On Feb. 5, 1938, the wires were removed and a 5/8 in. vitallium Venable screw was inserted into what had been the tooth socket. Fig. 1*B* shows the roentgenogram taken during the process of the insertion. The direction

the screw was taking was alarming. A check with the original x-ray, however, showed that the screw was assuming the direction of the original tooth. The screw was then further set in position. A celluloid crown form filled with a silicate cement was placed over the screw head for aesthetic reasons. Novocain anesthesia was used for insertion of the screw, and freedom from discomfort, immediately after or since the insertion, has been complete. Fig. 1*C* is an x-ray view taken February 24; Fig. 1*D* a similar view. March 31; Fig. 1*E*, two

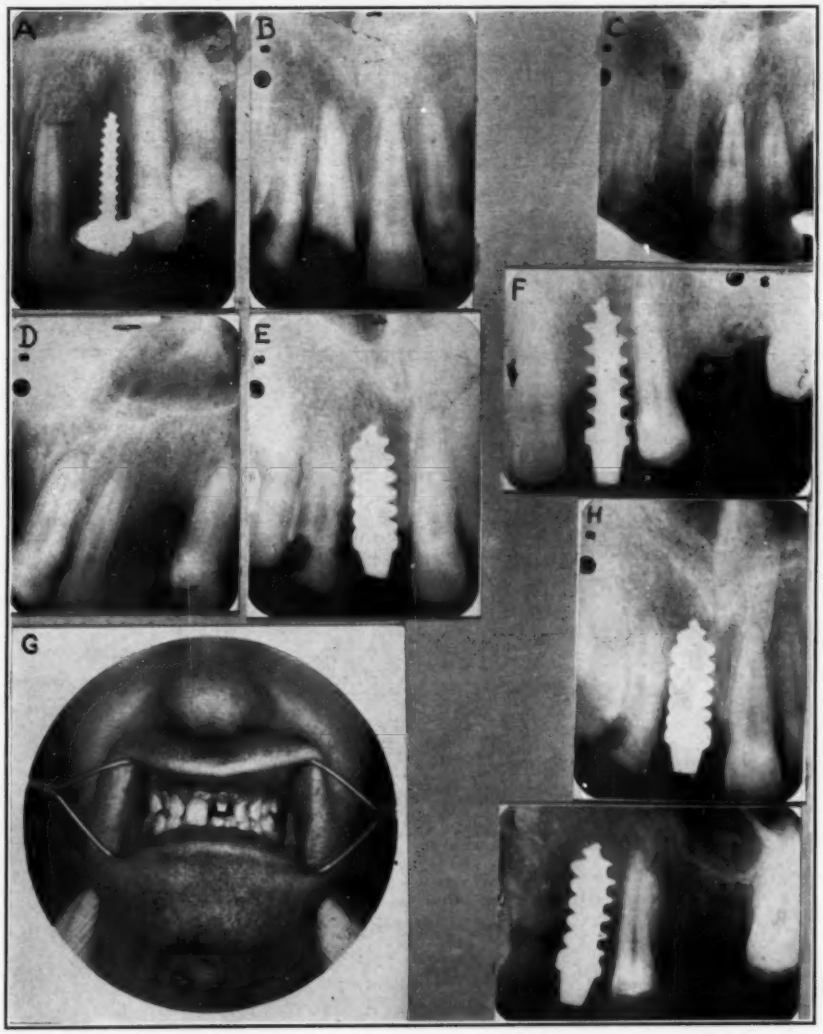


Fig. 2.

and one-half months later on April 17; and Fig. 1*F*, eight months later on October 6, show what appears to be complete bony repair of the original rarefied area and that there is no evidence of other disease. The screw on the last examination was moderately firm bucco-lingually but could be rotated. Fig. 1*G* is a photograph of the screw in position. The color and tone of the mucosa has always been normal around the implant.

2. D. S., aged 24 years, was first seen on February 21, at which time a 5/8 in. vitallium Venable screw was inserted into the canine space of the maxil-

lary right side (Fig. 2*A*). Although the patient described the extraction of the tooth as not recent, it was noticeable that there was a definite loss of bone at this point. The screw was inserted with great ease and was obviously not very firm. It was decided to allow the screw to remain to see whether it would tighten itself. A celluloid crown was cemented in place. At this time the maxillary left central incisor was extracted (Figs. 2*B* and *C*). The patient was observed for two weeks. The screw became extremely loose and was removed. It had been in traumatic occlusion. The patient never experienced any discomfort except the inconvenience such as accompanies a loose tooth prior to exfoliation.

On May 9 specially shaped vitallium posts were inserted into the central incisor and canine areas (Figs. 2*D*, *E* and *F*). During the insertion, threads of the central implant could be felt labially. Fig. 2*G* is a photograph four months later on September 3. The color of the mucosa is perfectly normal. The patient has never experienced any unfavorable symptoms, and, although no crowns have been placed, the patient chews with the posts quite freely. Figs. 2*H* and *I* are roentgenograms taken Dec. 6, 1938.

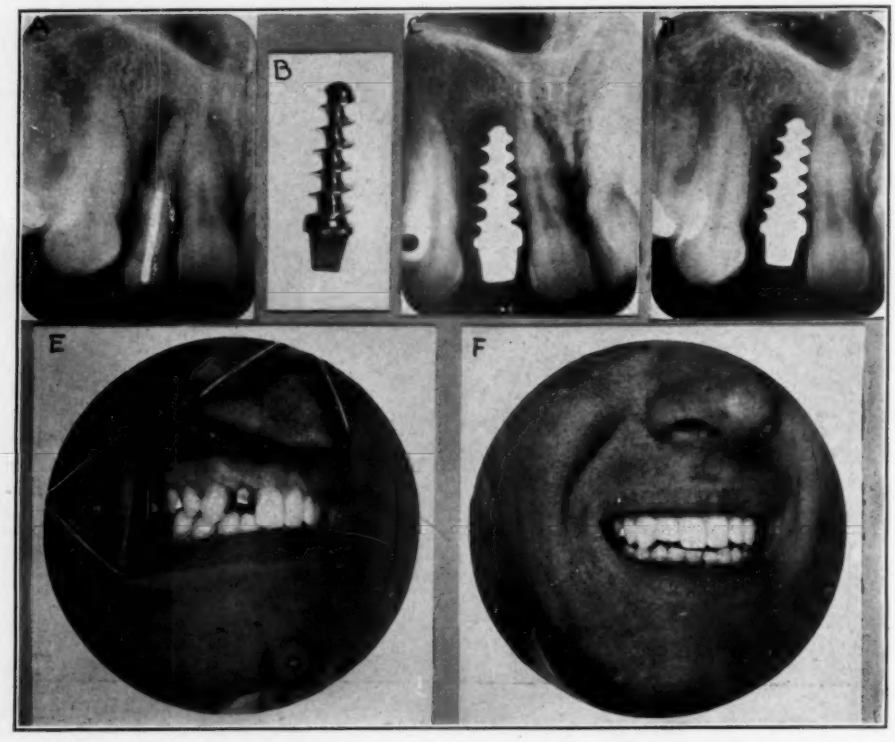


Fig. 3.

3. E. B. was first seen on May 23, 1938, while in the hospital for repair of a hernia. At this time he complained of pain in the maxillary right lateral incisor area. An x-ray of the tooth, which had been fractured many years before, showed a large area of rarefaction about the apex (Fig. 3*A*). On June 8, 1938, this tooth was extracted under local (novocain) anesthesia; no curettage was done; and a vitallium post (Fig. 3*B*) was inserted. Upper extraction forceps were used for insertion. Cleaning out of the diseased area as in cases

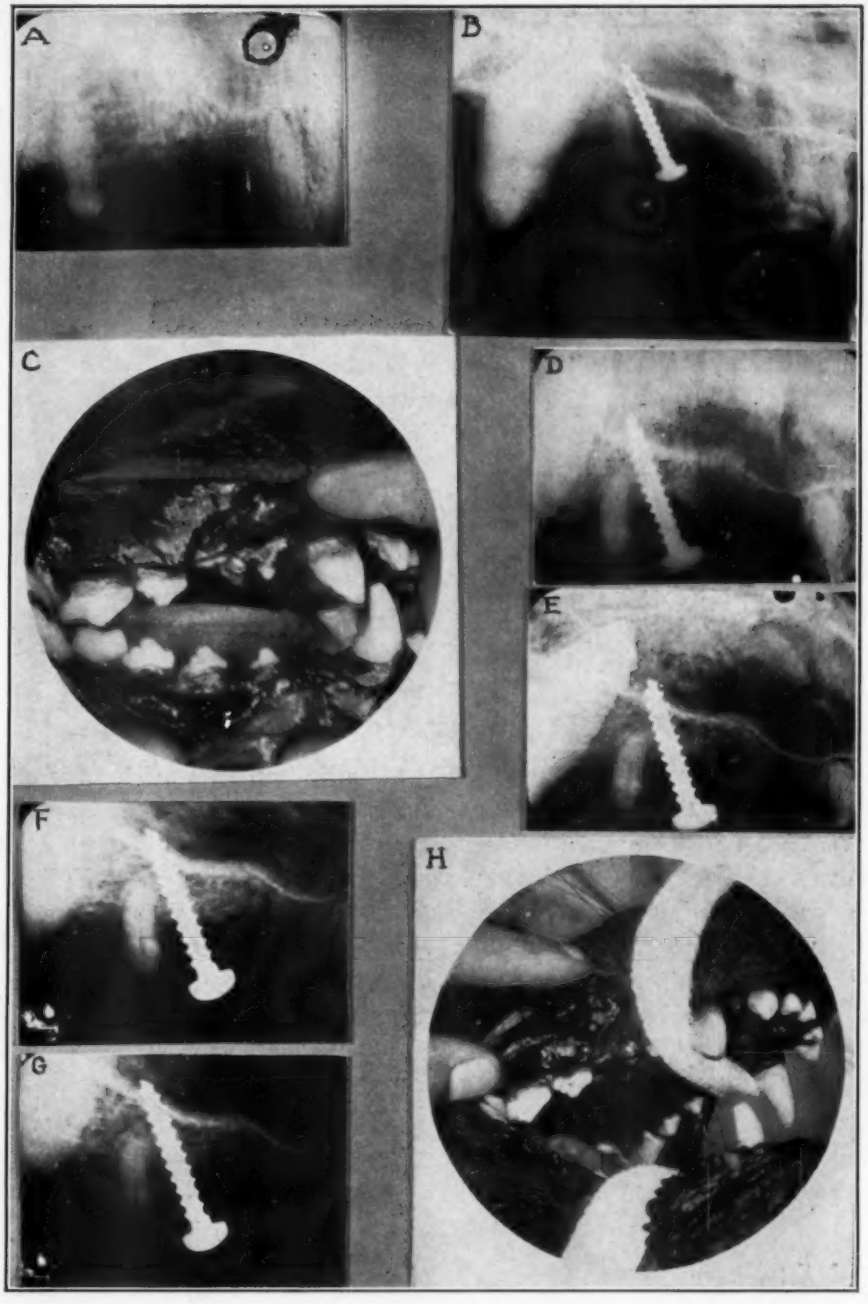


Fig. 4.

of root amputation might have been more judicious. However, an attempt has been made all along to take unfavorable cases and have them do well. Fig. 3*C* is an x-ray view on August 8, and Fig. 3*D* a similar view December 6. Fig. 3*E* is a photograph on July 15, and Fig. 3*F* a photograph on October 11. This tooth is firm and a good member of the dental arch. On November 17, the celluloid crown seen in Fig. 3*F* was successfully replaced by a porcelain jacket crown.

The following are observations on dogs:

1. On April 22, 1938, under intravenous nembutal anesthesia, a 5/8 in. vitallium Venable screw was inserted distally to the canine of the right maxilla of Dog 181-36. Fig. 4*A* shows the area previous to insertion. Apparently the tooth was missing for some time. Fig. 4*B* is the roentgenogram taken immediately after insertion. On May 15 there was some suppuration around the screwhead. An x-ray examination showed some resorption of the alveolar crest. On June 1 there was no sign of inflammation or abnormality of any kind, and a photograph (Fig. 4*C*) was taken. X-ray view (Fig. 4*D*) on June 24 showed filling in of bone on the alveolar crest, and Figs. 4*E*, *F*, and *G* on July 30, September 24, and November 28, respectively, show the filling in with bone complete. Fig. 4*H* is a photograph on September 24. This dog was on a regular diet and had been operated on several times for other experimental purposes by other members of the department. The screw is extremely firm and cannot be moved labiopalatally or rotated.

2. Dog 38-13: In this dog the mandibular left premolar area was selected, and on June 1 under intravenous nembutal anesthesia a 5/8 in. vitallium Venable screw was inserted. This experiment has made equally satisfactory progress, and now, six months later, the dog continues on a normal diet with the screw firmly in place.

CONCLUSION

The preceding evidence suggests that metallic implants made of vitallium, threaded at one end and shaped at the other to receive porcelain crowns and other prosthetic devices and inserted under aseptic conditions offer a simple and secure method of temporarily replacing certain missing teeth. Failure will result if too fine a screw is inserted into a tooth socket which has not completely filled in with bone, so that it can be secure from the start. If the screw is inserted immediately after extraction it must be large enough to be firmly imbedded into the alveolus. The occlusion should be favorable so that the tooth is not in trauma.

The work which has been done also seems to indicate generally that metallic implants, made of vitallium, which are used in the mouth are very well tolerated by the surrounding tissues, although the implants are not completely covered by mucosa.

REFERENCES

1. Kirk, E. C.: Dental Cosmos **15**: 432, 1913.
2. Greenfield: Implantation of Crown and Bridge Abutments, Dental Cosmos **15**: 366, 1913.
3. Zierold, A. A.: Reaction of Bone to Various Metals, Arch. Surg. **9**: 365, 1924.
4. Mathews, S. A.: Simple Wire Pin Skeletal Apparatus, J. Bone & Joint Surg. **13**: 595, 1931.
5. Carrels, W. B.: End Results in 100 Fractures Treated by Internal Removable Fixation, J. Bone & Joint Surg. **18**: 408, 1936.
6. Venable, C. S., Stuck, W. G., and Beach, A.: The Effects on Bone of the Presence of Metals; Based Upon Electrolysis, Tr. South. S. A. **49**: 294, 1937.
7. Stuck, W. G.: J. Bone & Joint Surg. **19**: 1077, 1937.

647 Commonwealth Avenue

TUBERCULOUS OSTEOMYELITIS OF THE MANDIBLE WITH TUBERCULOUS INFECTION OF THE ORAL MUCOSA

Report of a Case

Milton B. Asbell, D.D.S.,* and William C. Humphries, M.D.,
Baltimore, Md.

THE patient, G. A., was a negro male aged 6 years.

History.—This boy was transferred to Kernan Hospital from the Maryland Tuberculosis Sanitorium on March 25, 1938, because of tuberculous dactylitis and drainage of pus from a sinus in his gum under the left mandibular canine. He had been admitted to the sanitorium on Feb. 24, 1938, with a diagnosis of mediastinal tuberculosis. While at Kernan Hospital, a plaster splint was applied to immobilize the right thumb, and on May 13, 1938, an unsuccessful attempt was made to aspirate a soft tender mass below the right axilla lying superficially over the ribs. On July 30, 1938, the abscess on the thumb ruptured, and tubercle bacilli were found in smears from both the thumb and jaw. Later on, a fluctuant area on the right lower leg, posterior surface, began to drain. On Sept. 15, 1938, lymph nodes removed from each inguinal region for biopsy showed a typical picture of tuberculosis. The patient was admitted to the Baltimore City Hospitals on Oct. 3, 1938, for surgical treatment of the draining sinus on the mandible.

Fig. 1.—A profile view of the patient showing the "open-mouth" condition due to the lesion.

Examination.—Temperature was 100° F., pulse 124, respiration 26, and blood pressure 104/70.

The patient, a rather thin boy, was lying quietly in bed (Fig. 1). He had a cast on his right hand and forearm and a draining sinus on the dorsal surface

*From the Division of Dental Surgery, L. P. Henneberger, D.D.S., chief of the division, Baltimore City Hospitals.

of the interphalangeal joint of the right thumb. There was a shallow, red-based, fairly regular ulcer, one-half inch in diameter, on the posterior surface of the right leg. There was tenderness in the midline of the mandible, tenderness of the right thumb on manipulation, and tenderness over the fifth, sixth, and seventh right ribs at the anterior axillary line.

Fig. 2.

Fig. 3.

Fig. 2.—A view of the lesion with lower lip retracted.
Fig. 3.—Same view as Fig. 2 with the teeth in occlusion.

The mouth, which presented very little dental caries, sordes, or calculus, was normal for a child this age with the exception of the following: On the labial surface of the gum, in the midline of the mandible, there was a draining sinus out of which thick, yellow pus exuded (Figs. 2 and 3). The involved area was irregular in outline and extended laterally from canine to canine and superiorly-inferiorly from the labial fold to about one-fourth inch of the gingivae. The jaw was swollen, and the cervical lymph glands and the submaxillary glands of both sides were enlarged but not soft or tender. Because of the lesion the patient kept his mouth open constantly.

The chest was negative to physical examination. There was a healed one-inch scar in each inguinal region.

Laboratory Examination.—On Oct. 4, 1938, the urine was negative; white blood count, 6,150; hemoglobin, 8 gm., 54 per cent; Wassermann reaction, negative. Cultures on Oct. 7, 1938, showed pus from cold abscess on the thigh, Gaffky 2. There was no growth. On Oct. 29, 1938, a smear from the draining sinuses on leg and thigh revealed no tubercle bacilli, and on Oct. 31, 1938, the sinuses in the leg, thigh, and mandible showed no tubercle bacilli. Nov. 3, 1938, the smear from the sinus in the mandible revealed no tubercle bacilli.

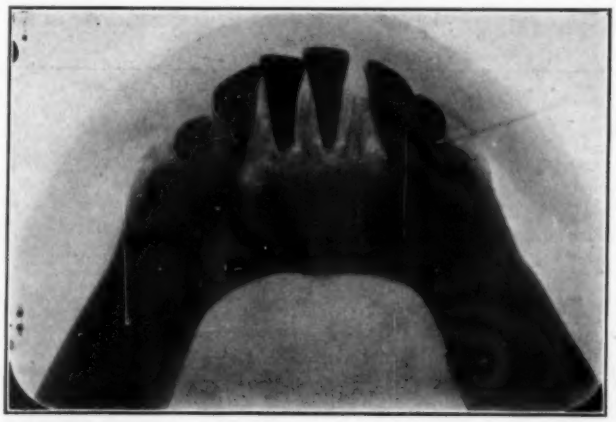


Fig. 4.—Radiographic view of the mandible eleven days preoperative. (See report for description.)

Fig. 5.—Radiographic view of mandible fifty days postoperative. (See report for description.)

Radiographic Examination.—(Dr. J. Pierson, Oct. 3, 1938.)

The right thumb showed a roughening and rarefaction of the first phalanx, probably due to an infectious process; osteomyelitis was suspected. The mandible showed a roughening with evidence of bone destruction in mental region. There was no evidence of involvement of other bones. Chest examination revealed a normal heart and aorta, enlarged hilar glands on the right, and clear lungs. Ribs showed no fracture, and the right leg no bony abnormalities.

Dental Examination.—On Oct. 10, 1938, the mandible showed osteoporosis of the anterior segment, with irregularly outlined areas of radiolucence, partic-

ularly about the apices of the anterior teeth (Fig. 4). On Oct. 26, 1938, the mandible showed anterior segment edentulous with osteoporosis involving same area irregularly outlined. On Dec. 7, 1938, right hand showed no change in appearance of right thumb. The mandibular incisor and canine teeth had been removed, and there is less rarefaction of mandible since last film. On Dec. 10, 1938, there was very little rarefaction of the mandible except at both canine regions (Fig. 5).

Diagnosis.—Tuberculous osteomyelitis of mandible in midline with chronic draining sinus in the mouth; tuberculous abscess of right thigh; tuberculous dactylitis of right thumb; abscess of right leg (no specific organism found); and malnutrition, secondary anemia.

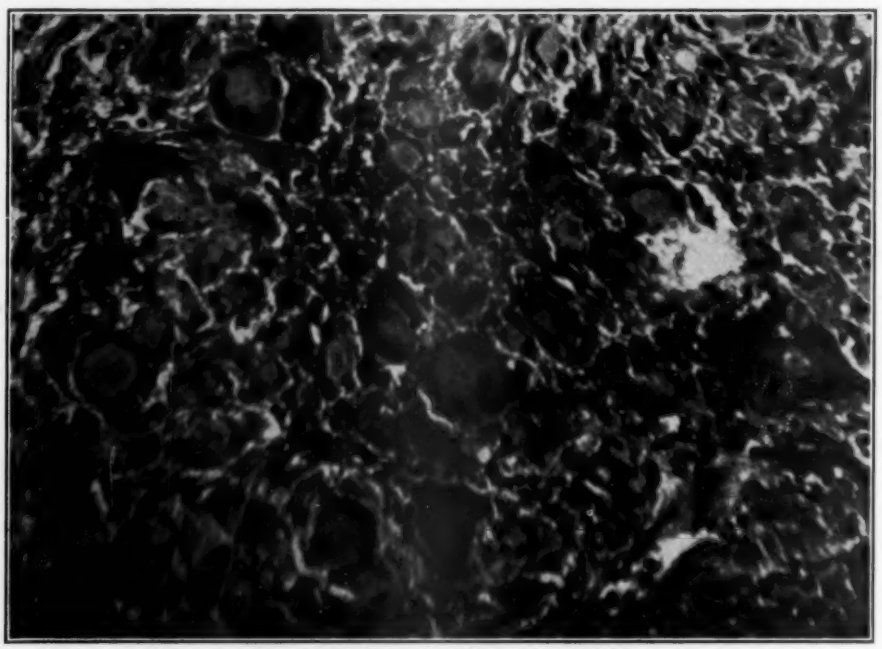


Fig. 6.—Photomicrograph of microscopic section shows many tuberculous giant cells and inflammatory infiltration of the connective tissue.

Operation.—On Oct. 21, 1938, the child was taken to the operating room and given avertin anesthesia (80 mg.). Six teeth, four mandibular permanent incisors and two deciduous mandibular cuspids, were extracted. His face was then cleaned with an alcohol sponge and draped with sterile towels. A mouth gag was inserted and an incision was made along the point of the alveolar ridge through the gum where the teeth had been extracted. A curet was inserted, and the necrotic bone which involved a considerable portion of the mandible in this region was removed. The gum which seemed to be necrotic at some points was débrided. After the curettement of the mandible was completed, the area was packed with iodoform gauze, which controlled the hemorrhage. The child was then returned to the ward in satisfactory condition. Postoperative diagnosis was tuberculous osteomyelitis of mandible in midline with chronic draining sinus into mouth.

Microscopic Examination.—The epithelium was hyperplastic. In the subcutaneous layer there were occasional well-formed hard tubercles composed of

central epithelioid cells surrounded by small numbers of lymphocytes and a moderate amount of fibrous tissue. Only two giant cells of the Langhans type were seen and these in association with two tubercles. No caseation was present. The remainder of the subcutis was scarred by dense fibrous connective tissue in which there were imbedded conglomerate and discrete numbers of lymphocytes. The process was obviously of a very chronic nature. An acid-fast stain was negative (Fig. 6). Diagnosis was tuberculous gingivitis. (Courtesy Dr. A. L. Braunstein, Department of Pathology.)

Course in Hospital.—For a few days postoperatively the sinus in the mandible was packed with iodoform gauze. Drainage cleared up moderately well, and the wound was not packed after Nov. 14, 1938.

The abscess on the dorsum of the right thigh was aspirated on Oct. 7, 1938, and the fluid obtained was found to be positive for tubercle bacilli. The small ulcer on the dorsum of this abscess enlarged in a few days to 1 cm. in diameter, and this sinus together with that on the right lower leg has drained slightly, but persistently, up until the present time.

The sinus on the thumb ceased to drain about a week after admission. The cast was removed from the right hand on Dec. 4, 1938, and there was still residual tenderness in the right thumb.

The patient was still without any complaint, and his course had been afebrile until Nov. 24, 1938, when he first developed an afternoon or early evening rise in temperature to 100 or 102° F. This has continued daily until the present time. Chest examination was still negative by physical findings and radiograph. On Dec. 17, 1938, the patient first noted slight tenderness in the right hip joint on extreme flexion of the thigh on the abdomen, but other than this possible explanation, we have found no cause for the rise in temperature. Radiographic examination of the right hip joint at this time was negative.

On Dec. 19, 1938, the patient was retransferred to the Kernan Hospital for further care.

4940 Eastern Avenue

STATISTICAL REPORT OF A SERIES OF FRACTURES

ARTHUR S. HAYNEN, D.D.S., NEW YORK, N. Y.

THIS report of mandibular, maxillary, and zygomatic fractures covers a series of 669 cases over a period of forty-six months. All of these cases occurred between 1935 and 1938, exclusive of two months in 1935. These figures add little new to what has already been published, but I am sure they will act as confirmatory evidence to what we believe to be standard for this work. This is particularly true since a fairly large and representative number of cases are considered.

The total number of mandibular fractures was 597 cases. Of this number 426, or 71.3 per cent, were single fractures, and 171 cases, or 28.7 per cent, were double fractures. Regarding the site or location of the single fractures, our figures agree very closely with other series. The results we obtained are shown in Table I in comparison with a set of figures previously published.

TABLE I

LOCATION	NO.	%	PREVIOUS FIGURES (%)
Angle	186	43.6	44.0
Mental foramen region	135	31.6	30.8
Molar region	36	8.4	8.8
Symphysis	31	7.2	8.8
Condyle	28	6.5	7.3
Coronoid	9	2.1	1.0
Ramus	1	0.2	

Regarding the location of double fractures of the mandible, these observations differ in many respects from those in other reports. A previous report showed the following percentage findings in all cases of double fracture.

TABLE II

LOCATION OF FRACTURES OF A PREVIOUS REPORT	%
Mental foramen on one side and angle of opposite side	77.4
The fracture lines passing through both mental regions	3.2
Fractures through symphysis and angle of one side	6.4
Fractures through condyle and mental region same side	3.2
Fractures through angle and mental foramen regions same side	6.4

Before I state my findings, I wish to point out that there are many sites at which a fracture can occur other than those locations mentioned above; thus we see that only five are mentioned when in reality there are many more, nothing as yet having been said of the coronoid process or of the molar regions. It, therefore, seems that 77.4 per cent is rather high for the mental region on one side and the angle of the opposite side, when there are at least twelve other combinations to consider. In Table III is a tabulation of the occurrence of our double fractures.

TABLE III

LINES OF FRACTURE	NO.	%
Mental region of one side and angle of opposite side	89	52.0
Condyle of one side and mental region of opposite side	20	11.6
Both mental foramen regions	16	9.3
Both angles	10	5.8
Symphysis and condyle of one side	8	4.6
Symphysis and angle of one side	6	3.5
Both molar regions	6	3.5
Both condyles	5	2.9
Condyle and mental foramen region same side	4	2.3
Mental foramen region and angle same side	2	1.1
Molar region of one side and mental region of opposite side	2	1.1
Coronoid of one side and mental region opposite side	1	0.5
Coronoid and mental foramen region same side	1	0.5
Molar region and mental region same side	0	0
Molar region of one side and opposite angle	0	0
Coronoid and angle of opposite side	0	0
Condyle of one side and opposite angle	0	0

However, it may be seen that by summing up the added possibilities in Table III not mentioned in Table II, and adding this total to 52.0 per cent, we arrive at a figure of 83.6 per cent which is close, within experimental error, to 77.4 per cent. Thus these added possibilities fill in the gap between my results of 52.0 per cent and 77.4 per cent, the result of previous findings. Table IV illustrates the method of fixation of these mandibular fractures.

TABLE IV

METHODS OF FIXATION	NO.	%
Intermaxillary direct wiring	314	52.7
Winter arches	181	30.3
Splints (metal or vulcanite) with circumferential wiring	82	13.7
Barton bandages or pressure bandages, no other treatment necessary	20	3.3

In reducing these fractures we used local anesthesia (novocain) in 482 cases and general anesthesia in 105 cases. Gas, oxygen-ether, or cyclopropane was used for general anesthesia. Evipal was used in two cases. No anesthesia was necessary in the remaining ten cases in which fixation was accomplished by wiring.

Cause of fracture in this series was strikingly different from that in other reports because of the location in the city where the patients were injured and the character of the patients as a whole.

TABLE V

ETIOLOGIC FACTORS	PREVIOUS FIGURES (%)	AUTHOR'S FIGURES (%)
Bare fist	49	90.0
Falls	14	4.0
Auto accidents	8	1.0
Extraction of teeth	5	0.0
Sports (principally hockey and football)	3	0.5
Miscellaneous	21	4.5

Approximate percentages have shown the relative frequency of mandibular fractures to fractures of the maxilla and related facial bones. Approximately 3 per cent of all fractures occur in the bones of the face. About 1 per cent of

all those occurring in the face are in the mandible. About 0.5 per cent are in the maxilla and 1.5 per cent are in the remaining facial bones.

Although not computed in the above reports, twenty-three maxillary fractures were also treated during the forty-six months and accounted for 3.5 per cent of all fractures. Also during this time forty-nine fractures of the zygoma were reduced accounting for 7.9 per cent of all fractures. The occurrence per year of all fractures including mandibular, maxillary, and zygomatic is given in Table VI.

TABLE VI

YEAR	NO. OF FRACTURES
1935*	124
1936	209
1937	162
1938	174
TOTAL	669

*In 1935 only ten months were computed, making this number of cases slightly smaller than the following three years.

Only one true fracture of the malar bone itself was treated. This may be easily understood when we consider that the malar bone is a strong bone on weak supports. Because of this fact, the body of the bone is rarely broken, but the four processes are frequently the fracture sites, namely the frontal, orbital, maxillary, and zygomatic. Fractures occurring here are always due to direct violence.

We found further that trismus was most marked in angle and condyle fractures and that about 150 pounds pressure was necessary to cause a mandibular fracture, although this varies considerably according to the direction of the blow, the presence of impacted teeth and cysts, and whether or not the mandible is edentulous.

Although actual records are not available, we believe that in about 40 per cent of these mandibular fracture cases osteomyelitis developed in the immediate locality of the fracture. I believe this is due principally to four factors: first, the large number of these fractures that were compounded into the mouth; second, inadequate care in oral hygiene both before and after the fracture occurred; third, the systemic condition of the majority of the patients; and fourth, the length of time elapsing before the patient came for treatment. A combination of any of these factors favors osteomyelitis, especially the fact that many of these patients did not come for treatment until three or four days, or even a week, after the break occurred.

I hope these facts and statistics will be borne out by future reports and further work along these lines.

The author wishes to acknowledge his thanks to Dr. Leo Winter, through whom this work has been made possible, and Dr. Wm. A. Fennelly, head of the Fracture Service, who encouraged this report.

REFERENCES

1. Curtis, L., and Ivy, R. H.: Fractures of the Jaws, Philadelphia, 1931, Lea & Febiger.
2. Blair, V. P., and Ivy, R. H.: Essentials of Oral Surgery, Ed. 2, St. Louis, 1937, The C. V. Mosby Company.
3. Mead, Sterling V.: Oral Surgery, St. Louis, 1937, The C. V. Mosby Company.
4. Silverman: Oral Surgery, Philadelphia, 1926, P. Blakiston's Son & Co.
5. History Records of the Bellevue Hospital.

BELLEVUE HOSPITAL

AN UNUSUAL MANIFESTATION OF A LEUCEMIA

MILTON NEGER,* A.B., D.D.S., NEWARK, N. J.

ON OCT. 5, 1938, a negro male, aged 28 years, was admitted to the Beth Israel Hospital in Newark, N. J., complaining of a throbbing pain on the right side of his mandible. It was of about two and a half weeks' duration and was accompanied by a marked trismus. Two dentists, whom he had visited previously, had failed to remedy his condition. Neither one had resorted to surgical intervention. He had come to the hospital on recommendation of his family physician, whom he had consulted a week prior to entering, because of the swelling on his mandible.

The patient was admitted to the hospital with the provisional diagnosis of "acute alveolar abscess."

Fig. 1.

Physical Findings.—Some of the important positive physical findings upon admission were as follows: The patient's temperature was 103.6° F. He had a large swelling on the right side of the face, involving the right submaxillary and the right submental regions (Fig. 1). It was hard and indurated, gradually blending into the surrounding tissue. This mass did not move freely from the deeper underlying tissue. There was no evidence of fluctuation.

There was a marked trismus of the jaws, permitting only a slight opening of the opposing, articulating teeth (Fig. 2). An intraoral examination showed hypertrophy of the gingiva which seemed to have a unilateral distribution. This

*Resident dentist, Beth Israel Hospital.

was localized to the right side of the mandible and the maxilla. The gingiva on the left side of the mouth was apparently normal. The illustration (Fig. 2) shows the peculiar unilateral distribution of the hypertrophied tissue. The crowns of the teeth were covered by the edematous tissue in an apronlike manner. Slight pressure on the gums caused bleeding, which was not of the spontaneous variety. The axillary and epitrochlear nodes were palpable and slightly enlarged.

The other physical findings were essentially negative.

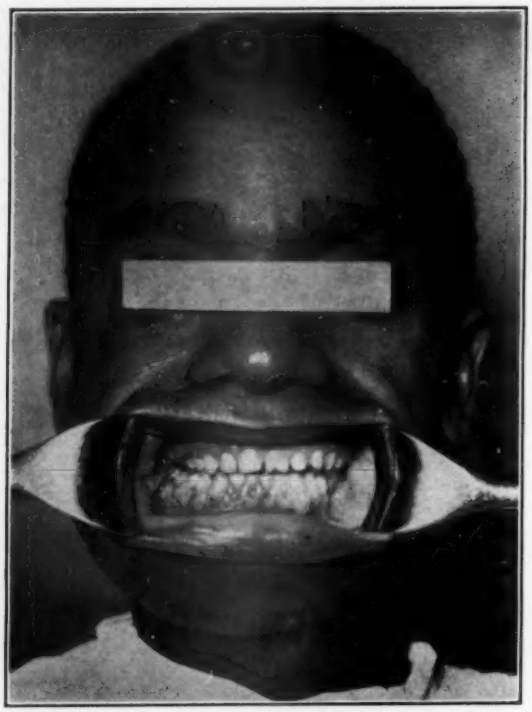


Fig. 2.

Laboratory Findings.—Reports from the laboratory procedures disclosed the following facts:

1. Wassermann and Kline tests were negative.
2. Urine was negative.
3. A mouth smear was negative for Vincent's spirochete and the fusiform bacillus.
4. Radiographic examination of the lungs was negative.
5. Radiographic examination of the jaws and the teeth revealed no evident abnormalities or pathology.
6. Blood picture was as follows:

a. Leucocytes—2,700. Normal—6,000 to 12,000.

(1) Polymorphonuclear leucocytes	12%	Normal 60 to 70%
(2) Lymphocytes	46%	Normal 20 to 30%
(3) Eosinophiles	5%	Normal 1 to 2%
(4) Monocytes	15%	Normal 5%
(5) Blasts (immature white cells)	15%	Normal none

(6) Stabs (young polymorphonuclear leucocytes) 7% Normal 1 to 2%

b. Erythrocytes—3,150,000. Normal—4,500,000 to 5,000,000.

c. Hemoglobin—72%.

d. Platelets—44,000. Normal—200,000 to 300,000.

Diagnosis.—The hematologic examination showed the presence of a blood dyscrasia. The presence of the 15 per cent blast cells or immature white cells, which are rarely found in the peripheral circulation of the normal person, substantiated a diagnosis of leucemia. The white cell count of 2,700 denoted a leucopenia or abnormal diminution in the number of the white cell elements. The diagnosis of acute leucopenic leucemia or acute aleucemic leucemia was thereby evident. This leucemia was accompanied by a secondary anemia and a low platelet count, which does at times appear with the leucemias.

The presence of the swelling on the right side of the face may be explained by the process of infiltration of the cells of the leucemic blood into the lymph nodes and the soft tissues of this area.

Further examinations of the blood were not made at the Beth Israel Hospital, because the patient signed his release after having been in the hospital for eight days. The progress of the case was followed to another hospital, the City Hospital, in Newark, N. J. The records at this hospital revealed a toxic patient, with a high temperature. There were no new positive findings. The patient died on Nov. 26, 1938, with no remission of symptoms prior to death. The cause of death was listed as "acute leucemia."

CONCLUSION

There are many interesting things to be noted in reviewing this case. The opinion of the practitioner, as well as the superficial examination of the patient, seemed to point to an infection of dental origin. We can well see how easy it might have been for a practitioner to have made a hasty diagnosis of acute alveolar abscess. This case illustrates the oft-stressed point of making a thorough examination of the soft tissues of the mouth and of taking x-rays of the teeth and jaws. The necessity of exercising the utmost caution before attempting to use any radical procedures cannot be overemphasized.

51 Seymour Avenue

CHANGES WITHIN THE MANDIBLE AND TEETH IN A CASE OF RICKETS

ELLIS B. JUMP, D.M.D.,* CHICAGO, ILL.

CERTAIN types of enamel hypoplasias have been recognized as the result of disturbances in the mineral metabolism since Fleischmann[1] in 1909 reported on the tooth changes in ten patients with tetany. Similar enamel changes were obtained experimentally by Erdheim[2] in parathyroidectomized rats. Shelling and Anderson[3] found more hypoplastic teeth in a group of 126 children with proved rickets than in a comparable rickets-free group. Sjoquist[4] in an extensive report described macroscopic dental hypoplasia in rachitic children from a school clinic in Sweden.

The consensus at present maintains that the histologic changes in the developing tooth germs are produced by essentially the same pathologic processes as occur in rachitic bones. Throughout the skeleton there is a retardation or cessation of endochondral bone formation and a failure of osteoid to calcify. The tooth germ changes characteristic of rickets have been described by Kronfeld[5] as follows: (a) Calcification of the dentinal matrix is retarded, as shown by a relatively wide zone of predentine. (b) Where the matrix has begun to calcify, the process is incomplete and uneven, thus producing large amounts of interglobular dentine which stains with eosin in a manner similar to predentine. (c) The odontoblasts gradually undergo atrophy, beginning first with those younger cells lying near the cervical border of the dentinal cap which are just beginning to function. (d) The border between the uncalcified predentine and the calcified dentine is irregular, and (e) cell inclusions within the matrix of the dentine are frequent.

Other workers[6, 7 8, 9] have described similar changes in the dentine of the teeth of rats and other experimental animals maintained for different periods on rachitogenic diets.

The histologic changes in the enamel organ of the teeth of infants associated with rickets are, according to Gottlieb[10]: (a) proliferation, metaplasia, and cyst formation within the stratum intermedium, (b) degeneration and scattering of the ameloblasts over the surface of the tooth, (c) areas in which the enamel is absent or greatly reduced in width, and (d) the formation within the disorganized regions of the enamel organ of irregular masses of calcified material staining with hematoxylin in a manner similar to immature enamel.

Uncomplicated rickets is rarely, if ever, the principal cause of death. Gottlieb's series of five children, ranging in age from 3 months to 18 months, included one case of enteritis, two of congenital syphilis, and two of pneumonia, of whom one also suffered from measles and the other from miliary tuberculosis.

From the Department of Pathology, the Children's Hospital and Infants' Hospital, Boston, and the Harvard Dental School.

*Research Fellow in Dentistry, Harvard University Dental School.

Burket[11] reported that in three patients with congenital syphilis he found defective enamel over the tips of the tooth cusps, associated with cystic areas and metaplasia of the ameloblastic layer, and amorphous masses of an eosinophilic material in the enamel organ. He also described hypoplastic odontoblasts and poorly calcified dentine, containing occasional pulp cells and capillaries within its matrix. These histologic changes in the tooth germ are similar to those Gottlieb has described as rachitic lesions. They also resemble the changes characteristic of vitamin A deficiency as described by Wolbach and Howe[12] in the teeth of rats and guinea pigs; Boyle,[13] likewise, found similar changes in the tooth germ of a human infant with a history of vitamin A deficiency. The morphologic variations from the normal in nutritional deficiencies of human beings can seldom be interpreted with the degree of exactitude that may be used when dealing with laboratory animals. Deficiencies in the diet of infants are usually multiple, and often the influence of infection on the nutritional requirements must be considered. Consequently, the interpretation of the above mentioned morphologic findings in developing teeth is unsatisfactory except in relation to changes in other tissues or to significant laboratory data.

The diagnosis of rickets may be made by two methods; first, characteristic changes in the epiphyseal region of growing bones which may be recognized by x-ray and by histologic examination, and second, characteristic variations from the normal in the absolute and in the relative amounts of calcium and phosphorus in the blood serum. Because of the serious illness of the patient to be reported, no data on the blood serum calcium and phosphorus were obtained. For the same reason the x-ray examination of the patient was incomplete. The characteristic changes, however, in the ribs, the long bones, the mandible, and the tooth germs are sufficient for a diagnosis of rickets.

CASE HISTORY

S. C., a white female infant 8 months of age, the youngest of eight siblings, was admitted to the hospital with a diagnosis of pneumonia and for treatment of skin lesions. Her mother had felt "fairly well" during the prenatal period. Birth and early postnatal development were entirely normal. The birth weight was 8 pounds. The child was bottle fed from birth. Cod-liver oil had been given, one-half teaspoon per day, after the age of 3 months (optimum dose is two to three teaspoons per day). Orange juice was given at irregular intervals. There was no history of previous illness except whooping cough at the age of 3 months.

Present Illness.—The present illness began one week before entry. Four days previously an abscess beneath the chin was incised with a free flow of pus and a subsequent fall in temperature from 103° F. to normal. On the day before entry the patient developed pneumonia.

Physical Examination.—Upon admission the physical examination showed an apparently well-developed and well-nourished infant, acutely ill, cyanotic, and in respiratory distress. Many large skin lesions with areas denuded of

epithelium were noted. Further examination revealed pneumonia in the upper left lobe, injection of the pharyngeal mucosa, and moderate enlargement of the liver and spleen. The laboratory data indicated a red blood cell count of 3.99 millions, with a hemoglobin of 80 per cent (Sahli), and a white blood count of 15,600 with a normal appearing differential smear. The radiographic examination was limited to the chest. The patient's course in the hospital was characterized by respiratory distress requiring the administration of oxygen. Death occurred on the fourth day of hospitalization.

Post-mortem examination performed four hours after death revealed "marked exfoliation of the skin resembling that seen in pemphigus," bronchopneumonia with pleuritis, acute splenitis, a general lymphadenopathy, bilateral otitis media, mastoiditis, and hemolytic streptococcus bacteriemia. There was marked beading on both external and internal surfaces of the ribs.

Teeth and Mandible.—A lateral radiograph of the posterior portion of the right mandible, following its removal, revealed slight general osteoporosis with coarse trabeculation of the medullary bone. There was no periosteal thickening. The deciduous second molar was calcified to the cervix, while the permanent first molar presented a continuous calcified marginal ridge with five well-formed cusps. The irregularity in density of the enamel on the posterior lingual cusp of the deciduous second molar and on the buccal cusp of the permanent first molar was suggestive of hypoplasia (Fig. 1).

Fig. 1.—Radiograph of the posterior portion of right mandible (×1½).

Microscopic Examination.—Sections of the costochondral junction presented evidence of both rickets and scurvy. The zone of provisional calcification was widened and irregular and not as well calcified as the normal. The trabeculae of the metaphyseal region were stained very lightly with hematoxylin, which usually denotes deficient calcification. Many hemorrhagic areas were seen along the costochondral line, although no subperiosteal hemorrhage was present. The proliferating cartilage was widened and thickened, causing marked beading on both external and internal surfaces of the ribs.

Two longitudinal sections of the mandible, stained with hematoxylin and eosin, revealed hyperplasia of the bone marrow and moderate thickening of the cortex beneath the deciduous second molar. This was associated with poorly calcified cortical bone and gross abnormality in the development of the deciduous second molar and permanent first molar tooth germs (Fig. 2).

The cortex of the bone appeared essentially normal except beneath the deciduous second molar where the deep layer of periosteum was thickened and contained a lightly staining intercellular substance. The medullary bone consisted of small trabeculae with smooth borders. No evidence of active bone formation was apparent. Several dark staining bands a short distance beneath the cortex indicated areas of bone resorption. The medullary spaces were enlarged and packed with hematopoietic tissue. In certain areas of the crypt walls, an eosinophilic cellular bonelike substance was present similar to that seen in the cortex.

The dental capsules of the deciduous second molar and permanent first molar presented an essentially normal appearance. Several recent minute hemorrhages and, in other areas, extensive diapedesis of red blood cells were observed. Both teeth, however, revealed striking abnormality of the calcified tissues.

Fig. 2.—Low power survey of one section. Note the gross enamel hypoplasia, proliferation of the stratum intermedium, and the widened predentine (×6).

The enamel organ over a greater part of the crown of the deciduous second molar was composed of a united enamel epithelium in which the stellate reticulum had disappeared. The ameloblasts were pyknotic, disarranged, and separated from the tooth surface in many places. In the cervical region of this tooth they presented an immature appearance, and enamel deposition was retarded. There was an area of metaplasia and proliferation of the stratum intermedium and outer enamel epithelium on the posterior surface of the deciduous molar and at several points on the permanent first molar (Figs. 2, 3, upper right). These lesions contained dense clusters and cords of immature epithelial cells. The largest of these areas showed early degenerative changes of the centrally located cells.

The outermost enamel of both teeth was poorly formed, except in the deciduous second molar where much of the enamel had been lost in preparation of the sections. It took an abnormally deep stain; the rods were arranged

irregularly, and several areas of grossly defective pitted enamel were observed. In two instances these pits were associated with the proliferative lesions of the enamel organ (Fig. 2, center). This peripheral zone of hypo-

Fig. 3.—Detail of an area of metaplasia of the stratum intermedium on the anterior aspect of the permanent first molar. Note proliferation of outer epithelium, cystic degeneration of centrally located cells, aplasia of ameloblasts, and local agenesis of enamel. On left, note greatly widened predentine, *p*, with small hemorrhages in pulp. *Inc*, prominent incremental lines (×110).

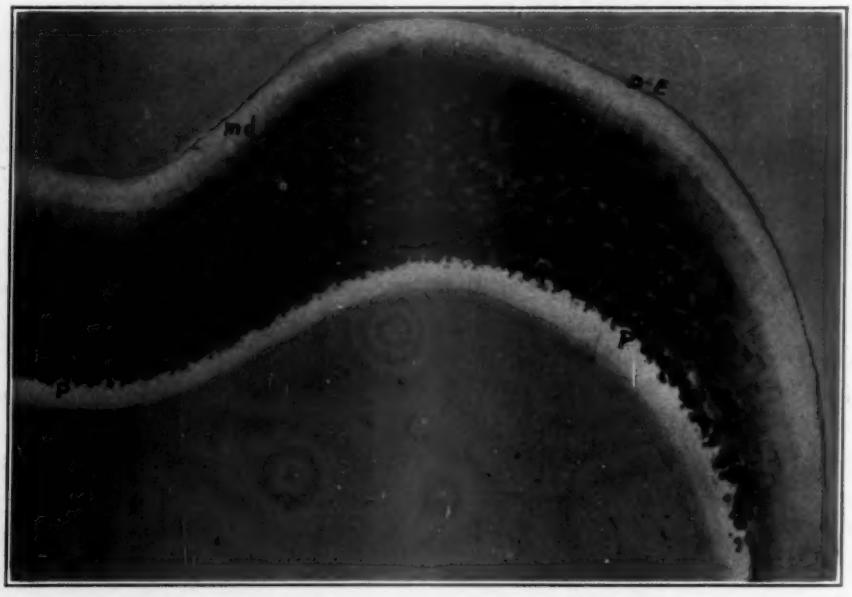


Fig. 4.—"Interglobular dentine" in crown of deciduous second molar. Note the widened predentine with an irregular calcified border. *D-E*, dentinoenamel border, *md*, mantle dentine, and *p*, predentine (×37).

plastic enamel was bounded on its inner border in the permanent molar by the second of two prominent incremental lines (Fig. 3, "inc," "inc_2") which lay 0.1 to 0.2 mm. beneath the surface of the crown. Corresponding developmental lines appeared in the dentine of both teeth.

Fig. 5.—High power view of posterior part of the permanent first molar showing aplasia of the odontoblasts and a greatly widened predentine, 6× as wide as the odontoblastic layer (×185).

In both the deciduous molar and permanent molar the dentine, other than the mantle dentine, was poorly calcified as shown by its mottled appearance. This interglobular dentine was particularly conspicuous in the deciduous molar (Fig. 4). The predentinal zone was wider than normal and presented an irregular outer border (Figs. 3 and 4, *p*). Its width varied from 50 to 100 micra. Beneath this predentine the odontoblastic layer of the pulp appeared hypoplastic and failed to exhibit its normal palisade arrangement. Several small hemorrhages were found in the odontoblasts or beneath them (Fig. 3 extreme left). The ratio of width between the predentine and odontoblastic layer ranged from 3 to 1 in parts of the deciduous molar to 6 to 1 on the posterior surface of the permanent molar (Fig. 5). The normal ratio is approximately 2 to 1.

DISCUSSION

Changes in the developing teeth indicative of rickets are the metaplasia of the stratum intermedium in the enamel organ and the defective calcification

of dentinal and enamel matrix, as evidenced by large amounts of interglobular dentine and by a greatly widened zone of predentine. These changes in calcification are similar in degree to those found in the costochondral junction of the ribs and confirm in certain respects the findings of Kronfeld and Gottlieb. With the onset of rickets calcification of the bone and teeth is retarded or stopped, although for a time the intercellular matrix continues to form. If the nutritional deficiency persists beyond this initial period, however, the matrix-forming cells are affected and undergo degenerative or metaplastic changes.

The atrophy of the enamel organ in the deciduous molar resembles the normal involution which occurs in this tissue after enamel deposition has been completed.

Although no definite orientation of the incremental lines in the enamel and dentine with respect to this patient's clinical history can be determined, the possibility must be considered that the inner line represents a "line of injury" associated with pertussis at 3 months of age and that the outer line was deposited during a second metabolic disturbance produced by the onset of the present illness.

The hemorrhages into the odontoblastic layer and other areas indicate definite vitamin C deficiency.[12]

SUMMARY

The case of an 8-month-old infant who died of bronchopneumonia and septicemia is reported. Evidence of rickets was established by post-mortem examination of the ribs and of the mandible and teeth. Prominent incremental lines in the enamel and dentine were described, and their relation to the case history was discussed. Characteristic rachitic changes in the teeth were marked interglobular dentine, a widened predentine, proliferation of the stratum intermedium, and hypoplasia and agenesis of the enamel.

REFERENCES

1. Fleischmann, L.: Verhand. d. 5 Internat. Zahnart. Kong. Berlin, 1909.
2. Erdheim, J.: Frankfurt. Ztschr. f. Path. **7**: 175. 1911; and Denkschr. d. k. Akad. d. Wissensch. Math-naturw. Klasse, 90. Wien, 1914.
3. Shelling, D., and Anderson, G. M.: J. A. D. A. **23**: 840, 1936.
4. Sjoquist, P. E.: Acta Paediat. Supp. 2 **19**: 281. 1937.
5. Kronfeld, R.: Histopathology of the Teeth and Their Surrounding Structures, Philadelphia, 1933, Lea and Febiger.
6. Becks, H., and Ryder, W. B.: Arch. Path. **12**: 358, 1931.
7. McCollum, E. V., et al.: Bull. Johns Hopkins Hosp. **33**: 202, 1922.
8. Klein, H.: J. A. D. A. **18**: 866, 1931.
9. Mellanby, M.: J. A. D. A. **17**: 1456, 1930.
10. Gottlieb, B.: Dent. Cosmos **62**: 1209, 1920.
11. Burket, L.: INTERNAT. J. ORTH. AND ORAL SURG. **23**: 1016, 1937.
12. Wolbach, S. B., and Howe, P. R.: Am. J. Path. **9**: 275, 1933.
13. Boyle, P. E.: J. Dent. Research **13**: 39, 1933.

950 EAST FIFTY-NINTH STREET

Case Reports

This month we present a case of acute monocytic leucemia by Dr. Thomas J. Cook of the University of Pennsylvania.

Case reports for this department should be sent to Dr. Kurt H. Thoma, 53 Bay State Road, Boston, Mass.

CASE REPORT NO. 25

ACUTE MONOCYTIC LEUCEMIA

Report of a Case With Oral Manifestations

Thomas J. Cook,* D.D.S., Philadelphia, Pa.

THE patient, a pallid white girl, aged 18 years, acutely ill, was admitted to the University Hospital on Oct. 19, 1938.

Physical examination revealed temperature 102.3° F., pulse 136, respiration 24, and blood pressure 120/54 (right arm). There were palpable nodes, varying from the size of a pea to several the size of marbles, on the submaxillary, anterior and posterior cervical, axillary and supraclavicular chains, which were discrete, firm, and nontender.

Fig. 1.—The papillae became hypertrophied, the gingiva thickened and necrosis began on the fifth day. The areas involved were painful and bled easily when touched.

Oral Examination.—The lips were pale, dry, and cracked. The teeth were in excellent condition. There were inflamed, ulcerated areas on the buccal mucous membrane about the right maxillary first molar and the mandibular incisor teeth (Fig. 1). The pharynx and soft palate were acutely inflamed,

*School of Dentistry, University of Pennsylvania, Philadelphia, Pa.

and there was a slight fetor oris. Smears from the gums revealed few Vincent's organisms.

The patient's blood picture established the diagnosis of an acute leucemia, a marked anemia, a low platelet count of 22,300 and a white blood cell count of 31,000 of which 95 per cent were indeterminate mononuclear cells which looked like the blast form. Bleeding and clotting time were normal.

Marrow puncture of the sternum, spreads stained with Wright's and Giemsa's showed the preponderant cell was the large immature mononuclear cell having the characteristics of the promonocytes. This cell constituted 85 per cent of the cells observed. In smaller numbers there were present blast cells (monoblasts), immature granulocytes, and a very few immature cells of the erythrocytic series; also there was a larger number of the mitotic forms than usually encountered.

The fifth day after admission the submaxillary glands were considerably swollen, and the mouth was the chief complaint. The mucous membranes were painful, ulceration extending posterior in the mandible to the molar region. On the lingual surface the gums were swollen, and there was some ulceration. There was a marked fetor oris. The patient's family insisted on taking the patient home where she died shortly afterward.

SUMMARY

In this case symptoms appeared in the mouth as one of the first signs of acute monocytic leucemia, and the patient's chief complaint while in the hospital was the swollen and ulcerated gums and the marked fetor oris which increased with the progress of the disease.

Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City.

Instructions to Parents of Children Receiving Orthodontic Treatment. By C. Scheidt. *Zahnärztl. Rundschau.* **12**: 482, 1939.

The importance of adequate cooperation by parents to the success of orthodontic treatment is well recognized. Hausser of Bonn and Gerlach of Berlin take issue with Scheidt as to just what parents should be told. Hausser and Gerlach are of the opinion that orthodontists only too frequently go into lengthy explanations of methods of treatment including histologic changes which, while of interest to the practitioner, serve only to confuse the layman. Furthermore, unanimity of opinion in all details of a diagnosis is hardly to be expected. It is more than likely that, if the parent seeks advice from a second orthodontist whose opinions do not coincide in all details with those of the first, the parent is confused, and his confidence is undermined.

Scheidt supplies information sheets in printed form to children undergoing orthodontic treatment. These read, briefly, as follows:

1. I require orthodontic treatment so that I may be better able to digest my food and to become and to remain healthy and strong.

2. Improvement in the position of my teeth is necessary so that I may be better able to keep my teeth clean and to prevent them from becoming decayed.

3. Although my health is more important than my looks, still when my teeth are improved it will improve my appearance.

4. I must stop breathing through my mouth because otherwise I catch cold easily.

5. The condition of my teeth can be improved if I cooperate with the doctor.

6. I must wear my appliance regularly as I am told. If I do not wear it, it cannot help me.

7. If I feel pain, I must report to the doctor, even if I do not have an immediate appointment.

8. I must use the appliance as I am instructed by the doctor.

9. The appliance will feel uncomfortable at the beginning, but I will get used to it very quickly.

10. The treatment of my teeth is all for my benefit.

Destruction of Tooth Enamel by Acidified Candies. By E. S. West and F. R. Judy. *Journal of Dental Research,* December, 1938.

Ordinary candy of acid reaction when placed in the mouth and allowed to dissolve slowly against the teeth forms a solution of a high pH, probably 3 to 4, between the surface of the candy and that of the enamel of the tooth with which it comes in contact. Prolonged and repeated dissolution of candy against tooth surfaces by habitual eaters of hard candies results in serious decalcification of the teeth, as indicated by experimental data obtained by these authors.

The occasional use of such candies has little effect. Because mouth temperature is considerably higher than in the experiments (20 to 25° C.), the rate of solution is increased. However, the importance of the buffer action of saliva in overcoming the acidity of the candy should be emphasized. Normal saliva afforded rather good protection against the dissolving action of 20 per cent acidified candy but served poorly in the more concentrated solutions. The destructive action on the teeth of different individuals varies with the buffer capacity of the saliva secreted. The amount of enamel dissolved does not represent the total destruction. Marked solution of tooth mineral showed a chalky insoluble layer on the surface which could easily be scraped off. The calcium-phosphorus ratio in this material was high because of the exchange of citrate ion of the solution for the phosphate ion of the enamel. The writers are of the opinion that this phenomenon of ionic exchange between tooth enamel and acidic groups of various foods may be an important factor in the general process of tooth destruction throughout the years of tooth life.

Unilateral Hypertrophy of the Mandibular Condyle Associated With Chondroma. By F. F. Kanthak, M.D., and H. N. Harkins, M.D. *Surgery* **4**: 898, No. 6, 1938.

These mandibular deformities result from abnormalities of the temporomandibular articulation. The disease occurs most frequently in young adults; the range of ages in reported cases was from 8 to 81 years, but generally the cases fell in the age range of from 20 to 35 years. The incidence is about equally divided between the two sexes.

A slowly progressive, unilateral, painless change in the size of the mandible develops, associated with deformity of the face and malrelation of the teeth. There is a deviation of the chin to the normal side, and a characteristic "crooked bite" results. There may be pain and crackling in the affected temporomandibular joint, but in general the attention of the patient is attracted by the increasing facial deformity and the difficulty in chewing properly. There is no limitation to movements of the jaw; the mouth can be fully opened, but lateral movements of the mandible arising from the affected condyle could not be performed in this case.

The condition is associated with one of three pathologic processes in the condyle: (1) chondroma, (2) cyst, or (3) osteoma. It seems likely that oc-

casionally a cartilaginous rest may remain and in later years resume growth, thus accounting for the chondromatous tumors noted in several of the reported cases. The unilateral deformity and progressive change in occlusion of the teeth are the salient features of the condition. Involvement of the condyle is indicated by the pivotal motion of the jaw. The movement of the mandible is always in the direction of the involved condyle.

The therapeutic attack on this problem may be divided into two phases: (1) the reduction of the deformity, and (2) the restoration of occlusion of the teeth. The external deformity may be reduced, and the disease eradicated by excision of the involved condyle. This permits the jaw to be swung backward farther into the glenoid fossa, reducing the facial asymmetry, and bringing the teeth to a more normal alignment. It is evident from a study of these cases that the deformity tends to progress continuously, and nothing is gained by waiting.

L. Clayman.

Thoughts on Reading R. Selmer-Olsen's Paper: "Tissue Reaction and Orthodontic Treatment." *British Dental Journal,* Jan. 16, 1939.

The conclusions seem to be: That growth which has not occurred at the appointed time cannot be recovered, from which it follows that we cannot make bone grow. That, as we do not know what is the tissue reaction to the forces we use, we cannot know what the histologic changes are. That reaction to appliances is most favorable during tooth eruption. The paper shows that it is imperative to appreciate the natural changes that may occur in the occlusion, e.g., opening of the bite (i.e., the correction of a supposed infra-occlusion) which has been shown to occur at 5 years, 7 years, and 13 years in different individuals, otherwise one may ascribe to appliances (an exogenous factor) changes which are of the endogenous order. Growth and tissue reaction to appliances are both changes, the former a natural phenomenon, and the latter the result of pressure, usually applied by artificial means, though occasionally from natural sources as in the case of Selmer-Olsen's "lip-activated" appliances demonstrated at the same meeting as that at which his paper was read. It is significant that Selmer-Olsen states that lack of growth is not regained as a matter of course: he says, if it is regained by treatment it is the result of tissue reaction, itself the result of exogenous factors or forces, and rendered possible by endogenous conditions: even this statement of possibilities of treatment, limited considerably in comparison with what it has been customary to teach, involves recognition of and a decision as to lack of growth, and if it did not, then the further question would arise whether the supposed lack of growth would not have disappeared in the course of time, leading to the belief that there was never actually lack of growth (though imperfect knowledge of what constitutes lack of growth may lead to such belief erroneously). If growth, i.e., insufficient growth, were not *un fait accompli,* there would probably not be an anomaly. One would like to know if the bone reconstruction the author refers to is an enlargement of the entire bone (e.g., in the case of the maxilla, of the apical base) or rather an increase

of superficies for muscle attachment. If one understands Selmer-Olsen rightly, every erupting tooth is synonymous with a growing up period for its area—it would be interesting to know if this is an interpretation of Professor H. A. Harris' views which meets with his approval: it does not strike one as feasible that the maxillae should have the same number of "growing up" periods as teeth, viz., 52; even if it were so, is it not possible that the area for an unerupted tooth needs to be provided in some instances before its eruption? In the case of the second premolars they require less room than their predecessors. Even in man it seems that the loss of deciduous teeth and the eruption of the permanent ones is a more or less continuous process from 6 to 12 years of age. Age alone is not satisfactory as data.

The author does not make it sufficiently clear what is meant by *variability* of tissue reaction. He refers to frequent infraocclusions of the molar series, and other supposedly abnormal conditions, which have been shown to exist at birth. Here is a supposed abnormality existing at birth and if due to an endogenous factor it must have operated before birth and therefore would not such factor be something even more remote than the term endogenous might imply? Undoubtedly some infraocclusions, so diagnosed, have disappeared in the course of time without treatment—models to show this at 5 years and 7 years were shown at the meeting (here is an example of a supposed abnormality disappearing without treatment at differing ages). The primary consideration is to diagnose "normal," atypical growths, i.e., occlusions which a few years ago would have been diagnosed as abnormal, but may in fact be normal, may be difficult to recognize as normal, or that they will become what is commonly regarded as normal if one bears in mind the wide variation of normal.

The message of Selmer-Olsen's paper is one of importance because it raises the very pertinent question—What are the tissue changes incidental to the movement of teeth by appliances? What are the limitations of orthodontic treatment? What natural changes will occur as regards occlusion? And finally, what is normal?

Editorial

The Kansas City Meeting of the American Association of Orthodontists

THE oft-repeated assertion that the American Association of Orthodontists is one of the most vigorous, enthusiastic, and fraternal organizations in American dentistry was again amply justified at the Kansas City meeting. This was evidenced by the large attendance, the quality of the program presented, and the serious, close attention paid to the presentations of all of the interesting essayists, who had given so much time to the preparation of their papers, case reports, and clinics.

The Thirty-Seventh Annual Meeting of the American Association of Orthodontists really started Saturday and Sunday, April 15 and 16, at which time meetings of various and sundry committees were held. Also on Sunday the American Board of Orthodontia held an all-day session.

Monday morning opened with the annual golf tournament at the Mission Hills Country Club and, if the turnout at this event can be taken as a criterion, the annual tournament has evolved into an important feature of the annual meeting. It affords opportunity for the formation of friendships, as well as acquaintances throughout the nation, among men interested in the special practice of orthodontics. The day devoted to golf and recreation was followed in the evening by the annual stag banquet and get-together in the Hotel Muehlebach. The ever-jocular and genial Paul Spencer, of Texas orthodontic tradition, acted as the master of ceremonies and appropriately added a touch of the gridiron dinner atmosphere to the occasion by injecting in his own vernacular "a little clean fun." Professional entertainers contributed to the attractions of the evening. They were followed by the presentation of the prizes to the various contestants who took part in the day's tournament.

The program proper opened at the Muehlebach Hotel Tuesday morning with an executive session of the Association. This was followed by an address of welcome by Dr. Clarence R. Decker, president of Kansas City University, and this was ably responded to by President-Elect Henry U. Barber of New York City.

Dr. Harry Allshouse then delivered the President's Annual Address to the Association, and Past President James D. McCoy of Los Angeles, Calif., read the first paper of the session. The remainder of the program proved to be unusually interesting and reflected the careful preparation on the part of the essayists, painstaking and careful selection, and months of effort on the part of the program committee.

Tuesday evening, the general clinics were in place, and the entire evening was devoted to them. The contributions were notable in the wide variation of material, the new ideas presented, and the wide interest that was shown by

the members present. The interest was so keen that some of the clinicians were asked to reopen their clinics in their rooms for further demonstration, after the conclusion of the regular clinics.

The president's annual reception, held Thursday evening, was immediately followed by the banquet. The usual speaking program was dispensed with, and the annual get-together got away to a rapid tempo with the help of a fast-moving floor show.

In addition to the scientific program on Thursday morning, the Albert H. Ketcham memorial award was conferred upon Dr. Milo Hellman of New York City by the American Board of Orthodontia in appreciation of his outstanding contributions to the scientific advancement of orthodontic practice. A more complete record of the presentation will be published in a future issue of the journal, and this, no doubt, will enable the members of the association who did not attend to know more of Dr. Hellman's contributions to orthodontic advancement.

The meeting will be held in Chicago next year under the leadership of Dr. William A. Murray and the elected and appointed committees. The following officers and committees were elected to lead the Association during the remainder of the years 1939 and 1940:

President, W. A. Murray, Evanston, Ill.
President-Elect, Henry U. Barber, Jr., New York, N. Y.
Vice-President, J. A. Gorman, New Orleans, La.
Secretary-Treasurer, Claude R. Wood, Knoxville, Tenn.

ELECTED COMMITTEES

Judicial Council:
Dr. Fred Wolfsohn, San Francisco—3 years
Dr. Glenn F. Young, New York City—1 year
Budget Committee:
Dr. Floyd E. Gibbin, Buffalo—3 years
Revision of Constitution and By-laws:
Dr. Mort Henkin, Sioux City, Iowa—3 years
Education Committee:
Dr. Leland R. Johnson, Chicago—3 years
Publication Committee:
Dr. J. W. Ford, Chicago—3 years
Public Relations Committee:
Dr. Frank Nicolai, Brooklyn—3 years
Research Committee:
Dr. G. Vernon Fisk, Toronto—3 years
Relief Committee:
Dr. John E. Taylor, Hollywood—3 years

President Allshouse and his committees who handled this year's meeting in such an efficient manner will, no doubt, enjoy the gratitude of the entire membership for having been responsible for the hospitable entertainment of the visitors and for having arranged and completed a highly profitable and successful meeting of the Association.

The American Association now, being made up of a number of sectional component societies, since its reorganization on a national scale, enjoys a membership of exactly 590 members. When it is recalled that about the time of the World War a mere handful of men met at these annual conclaves, when it is noted that men now attend these get-togethers from coast to coast and from every state in the union, it is not difficult to get the impression that the specialty is a rapidly growing department of dentistry, and what is yet to come is only a conjecture. The registration at the Kansas City meeting was about 300, a trifle more than that at the Los Angeles meeting last year.

It is easy to get the impression, after attending one of these meetings, that step by step, year by year, the merits of orthodontic practice as an important contribution to child welfare are not only rapidly coming into their own, but that the orthodontist is becoming more and more sure of his work and believes that by a communion of purpose much greater things are yet to come. By greater knowledge and comprehension of the problem in hand, orthodontic practice is becoming less unwieldy and is becoming simplified for those who follow through and watch the trends of progress.

H. C. P.

In Memoriam

Harry A. Holder

Harry A. Holder, an early orthodontist of Nashville, Tenn., passed away Feb. 9, 1939, following an illness of several weeks. Dr. Holder was 59 years old. He was a native of Tennessee and a graduate of Vanderbilt University, class of 1901. After having practiced in Gallatin, Tenn., Dr. Holder decided to take up the practice of orthodontics in 1921. He attended the Dewey School of Orthodontia in New York, then took up the work as a specialty in Nashville.

Dr. Holder was a past president of the Southern Society of Orthodontists; he also served for a time as secretary of that society. He was past president of the Fifth District Dental Society of Tennessee, also of the State Dental Association of Tennessee.

In addition to his professional career, Dr. Holder was active throughout his life time in church, civic, and fraternal organizations. He was a member both of the Kiwanis Club and the University Club.

Dr. Holder is survived by his wife, four sons, and one daughter, all of Nashville, and three brothers.

Dr. Holder will be remembered among orthodontists as an enthusiastic, religious, hard-working man for the subject and his work. Before ill-health overtook him, he was active, alert, and always present at orthodontic conclaves throughout America. The specialty is called upon again to bow its head in remembrance of another who helped write the first chapter of orthodontic history in America; to one who helped carry the orthodontic message to the entire South when the message was both difficult to write and difficult to read.

To Harry Holder goes the respect of those who remain and remember his life of effort and accomplishment.

H. C. P.

News and Notes

Dental Survey

A nationwide survey made with the cooperation of the American Dental Association contains the most recent and authoritative data available on the subject of dental incomes. Average net income from professional services including professional salaries of practicing dentists in the United States in 1937 was $2,914. This compares with averages of $4,273 in 1929 and $2,251 in 1933. Incomes are analyzed from the standpoint of years of practice, type of work (nonsalaried, part salaried, or 100 per cent salaried) and by geographic location.

To Train Dental Interns in Army Hospitals

The United States Army is for the first time undertaking to train dental interns in its hospitals. Announcement of this new departure, seen as a development that will make the army dental service more effective as a health service, was made by Brig. Gen. Leigh C. Fairbank, Chief of Dental Staff, United States Army, at the meeting of New York's Second District Dental Society. Brig. Gen. Fairbank is the first dentist to reach this rank in the Army.

Outstanding graduates of dental schools this year will be chosen for the new Army hospital internships.

European Orthodontic Society

The annual meeting of the European Orthodontic Society will be held at Bonn-Wiesbaden, Germany, on July 3-6, 1939. The officers of the society are: President, Harold Chapman, London; vice-president-elect, Gustav Korkhaus, Bonn; vice-president-elect, A. E. Rowlett, Leicester; secretary, G. F. Cale-Mathews, Birmingham; and treasurer, O. Henry, London. The provisional program of the meeting appeared in the April issue of the JOURNAL.

Mississippi Dental Association

The Mississippi Dental Association will hold its annual meeting at Gulfport, Miss., June 12 to 14, 1939, with headquarters at the Markham Hotel.

GEORGE P. EVANS, Secretary.

Ontario Dental Association

The seventy-second annual convention of the Ontario Dental Association will be held at the Royal York Hotel, Toronto, Ont., June 5 to 7, 1939. Dentists from the United States and from parts of Canada outside Ontario are welcome.

FRED J. CONBOY, Secretary.

Denver Summer Seminar

The fourth annual Denver Summer Seminar will be held at Denver, Colo., July 2 to 9, 1939.

WILLIAM R. HUMPHREY
1232 Republic Building
Denver, Colo.

University of Pennsylvania Postgraduate Courses

The School of Dentistry of the University of Pennsylvania offers two special postgraduate courses as follows:

1. Four-day general refresher course, including local and conduction anesthesia, radiography, bacteriology, full-denture prosthesis, partial-denture prosthesis, ceramics, gold inlay, periodontia. The course will be conducted by the faculty of the school, aided by well-known specialists in the fields concerned, from Monday, June 5, to Thursday, June 8, 1939, inclusive. The fee is $10, payable with application.

2. Ten-day course in oral surgery, exodontia, and local and general anesthesia. The course will consist in part of lectures on the subjects mentioned, supplemented by lectures and demonstrations in anatomy, bacteriology, pathology, and roentgenology, pertinent to the clinical subjects. Most of the time will be spent in clinical instruction at the Evans Institute and at various hospitals. This course will be held Monday, May 29, to Thursday, June 8, 1939, inclusive. The fee is $75, $25 to be sent with application and $50 payable at time of registration at the school.

Applicants should state their school and class and dental society affiliation. Courses are not necessarily restricted to University of Pennsylvania graduates, but alumni will be given preference in case the numerical limits are exceeded.

Application for either course should be made to

THE DEAN, School of Dentistry, University
of Pennsylvania
Evans Institute, 40th and Spruce Streets
Philadelphia, Pa.

French Speaking Dentists of North America

The fifth convention of the French Speaking Dentists of North America will be held at Montreal, Mount Royal Hotel, June 8-10, 1939.

DR. GERARD BAILLARGEON
Medical Arts Building
Montreal, Canada

American Dental Assistants Association

The fifteenth annual session of the American Dental Assistants Association will be held at Milwaukee, Wis., July 17 to 21, 1939, with headquarters at the Astor Hotel. For further information address

LUCILE S. HODGE, General Secretary
401 Medical Arts Building
Knoxville, Tenn.

Notes of Interest

Dr. George R. Moore announces Dr. Charles M. Waldo as an associate in the practice of orthodontics at 919 Oakland Avenue, Ann Arbor, Mich.

Dr. George H. Gowen announces that he has succeeded to the practice of Dr. Burt Abell and will continue his practice at 443 West Bancroft Street, Toledo, Ohio. Practice limited to orthodontics.